REPORT RESUMES

ED 020 805 24 PS 001 047
THE TEACHING OF INQUIRY SKILLS TO ELEMENTARY SCHOOL CHILDREN.
FINAL REPORT.
BY- ALLENDER, JEROME S.
MIAMI UNIV., OXFORD, OHIO
REPORT NUMBER BR-5-0594 PUB DATE 31 MAY 68
CONTRACT OEC-6-10-158
EDRS PRICE MF-$0.75 HC-$7.16 177P.

DESCRIPTORS- *INQUIRY TRAINING, *ELEMENTARY SCHOOL STUDENTS, INTERMEDIATE GRADES, *SELF DIRECTED GROUPS, *INDIVIDUAL ACTIVITIES, INDIVIDUAL STUDY, INDIVIDUAL INSTRUCTION, MOTIVATION TECHNIQUES, MEASUREMENT TECHNIQUES, TEACHING TECHNIQUES, INSTRUCTIONAL FILMS, PEER TEACHING, PROGRAMED INSTRUCTION, INSTRUCTIONAL MATERIALS, *EDUCATIONAL STRATEGIES,

A SERIES OF EXPERIMENTS HAVE BEEN CARRIED OUT OVER A PERIOD OF 3 YEARS TO FIND MEANS FOR DESCRIBING INQUIRY BEHAVIOR IN GRADE SCHOOL STUDENTS AND TO TEST THE EFFECT OF TEACHING METHODS AND ENVIRONMENT ON THIS BEHAVIOR. INQUIRY ACTIVITY WAS TESTED BY HAVING CHILDREN PLAY THE ROLE OF A SMALL CITY MAYOR USING SPECIALLY DEVELOPED MATERIALS. THREE SEPARATE STUDIES WERE CONDUCTED. IN THE FIRST, 51 FROM THE MATERIALS. ALL WERE ABLE TO SUSTAIN INDEPENDENT ACTIVITY, BUT WIDE DIFFERENCES IN THE LEVEL OF ACTIVITY WERE OBSERVED. IN THE SECOND STUDY, 177 ADDITIONAL STUDENTS IN THE THIRD THROUGH SEVENTH GRADES WERE GIVEN ONE UNIT OF WORK. COMBINING THEIR SCORES WITH THE FIRST UNIT SCORES OF THE PREVIOUS STUDY, IT WAS FOUND THAT THERE WAS A GENERAL TENDENCY FOR INQUIRY ACTIVITY TO INCREASE WITH GRADE LEVEL, BUT THERE WERE NO SIGNIFICANT EFFECTS ATTRIBUTABLE TO SEX, INTELLIGENCE, OR READING LEVEL. IN THE THIRD STUDY, TWO EXPERIMENTS WERE CONDUCTED TO SEE IF INQUIRY BEHAVIOR COULD BE TAUGHT. THREE MEANS OF TEACHING WERE TRIED WITH 20 FIFTH GRADE CHILDREN IN THE FIRST EXPERIMENT, BUT NO EFFECT ON INQUIRY ACTIVITY WAS NOTED. A SECOND EXPERIMENT, USING A SPECIAL TRAINING CENTER, WAS CONDUCTED WITH 54 FIFTH GRADE CHILDREN, WHO WERE DIVIDED INTO THE CENTER SHOWED INCREASING INQUIRY ACTIVITY, BUT NO DIFFERENCE WAS NOTED BETWEEN TEACHER-DIRECTION OR STUDENT-DIRECTION, LEADING TO THE CONCLUSION THAT THE SPECIAL ENVIRONMENT WAS THE CRITICAL FACTOR. (DR)

BR-5-0594
PA-24

ED020805

FINAL REPORT

Project No. 5-0594
5-PA-24
Contract No. OE-6-10-158

THE TEACHING OF INQUIRY SKILLS TO ELEMENTARY SCHOOL CHILDREN

May 1968

U. S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

PS001047

U. S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

RECEIVED
JUL 24 1968

Final Report

Project No. 5-0594
Contract No. OE-6-10-158

THE TEACHING OF INQUIRY SKILLS TO ELEMENTARY SCHOOL CHILDREN

Jerome S. Allender

Miami University

Oxford, Ohio

May 1968

The research reported herein was performed pursuant to a contract with the Office of Education, U. S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

Office of Education
Bureau of Research

PS 001047

PREFACE

The research reported here took place over a period of three years. During that time, more than one hundred people were involved in the many different phases of the project; many of them became actively interested in the research. There were cooperating superintendents, principals, and teachers; there were mothers who participated as experimenters, undergraduate and graduate students who worked with the development of materials, as experimenters, and in the analysis of data, and there were Miami University staff members and students who worked for the audiovisual service and the computer center. Even their numbers are diminished by the hundreds of children who participated in the pilot experiments and in the studies reported in the following chapters. It is appropriate that research into the inquiry process has involved an open inquiry itself. It is because so many of these people wanted to know the meaning of what we were doing, because they asked questions, and because they conscientiously suggested changes that the inquiry followed a meaningful path.

A fewer number participated in critical roles; the successful completion of the project was dependent on their work as parts of the whole. Donna Allender took most of the responsibility for translating the theoretical ideas into real materials that the children could use. Robert Brower and Anthony Mostardo, administrators in the Elk Grove School System, helped shape the materials and experimental methods into forms that would allow for their use in actual school settings. Four colleagues, Bradley Blanton, Daniel Elazar, Eugene Jabker, and Lee Shulman, spent many hours reading and returning necessary critiques of materials, analyses, and the final writing. George Luhr, head of the instrument shop at the University of Vermont made it possible to break endless numbers of mental sets in the building of the equipment. Donald Dutter and Edward Jurowski, graduate assistants at Miami University, devised the system of data analysis bringing literally pounds of raw data from the experimenters through the computer center and back to the laboratory in useable form. The efforts of all of the people working on the project were coordinated by Hedy Zussman; in addition to being staff director, she directed the movies, trained the experimenters, designed the laboratories and the learning centers--a complete list would be very long. In the background of all of this activity, Carol Jones, the project secretary, ostensibly calm, always saw to it that the typists had the materials completed on time, that letters were answered, that the everyday business was in a state of order and finally that the typing schedules and standards for the technical quality of the final report were met.

Working together with all of these people, the named and the unnamed, has made this an exciting project to carry out. If I might speak for all of us, we hope that our efforts might add some knowledge to the problem of teaching inquiry skills to children.

JSA

TABLE OF CONTENTS

Chapter **Page**

SUMMARY. 1

1 INTRODUCTION 7

2 METHODS. 18

Inquiry Materials 18

Measurement Procedures. 20

Teaching Materials. 31

General Design. 34

3 CHARACTERISTICS OF INQUIRY ACTIVITY. . . . 41

Results 43

Discussion. 60

4 DEVELOPMENTAL TRENDS 64

Results 68

Discussion. 74

5 TEACHING METHODS AND ENVIRONMENTS. 80

Experiment I. 80

Results 83

Experiment II 86

Results 90

Discussion. 99

6 GENERAL DISCUSSION AND CONCLUSIONS 104

REFERENCES 110

Appendix | Page

A INDIVIDUAL INSTRUCTIONS FOR PLAYING THE MAYOR. 115

B TECHNICAL MANUAL FOR THE INQUIRY RECORDER written with the assistance of Edward S. Jurowski and illustrated by Robert Karol. 132

C LETTERS USED IN TEACHING MATERIALS 142

D THE MAYOR'S WORK 146

E GROUP INSTRUCTIONS FOR PLAYING MAYOR . . . 157

F SCRIPT FOR INSTRUCTION MOVIE by Hedy Zussman. 160

LIST OF TABLES

Table **Page**

1 Sample Size for the Study of the Characteristics of Inquiry Activity 44

2 Contingency Table: Number of Experimental Sessions vs. Total Inquiry Time. 44

3 Correlation of Scores on Units of Work with Scores Obtained Last. 48

4A Grand Means Per Unit of Work and Intercorrelations Among Inquiry Scores (N = 51) 51

4B Grand Means Per Unit of Work and Intercorrelations for Three Groups Differentiated on Inquiry Time. 51

5 Analysis of Variance of Differences Between Three Groups Differentiated on Inquiry Time 54

6 Mean Variance and F-Ratios for Three Groups Differentiated on Inquiry Time 54

7 Contingency Tables: Grade Level and Sex vs. Inquiry Time. 57

8 Contingency Tables: UI/SQ and UI/UI Time vs. Inquiry Time 58

9 Contingency Tables: Total Inquiry Scores for One Experimental Session (the second) vs. Inquiry Time 59

10 Contingency Table: Inquiry Time for One Experimental Session vs. Inquiry Time. 57

11 Sample Size for the Study of Developmental Trends. 66

Table		Page
12	Subsample Size for the Study of Developmental Trends.	66
13	Mean Inquiry Scores by Sex and Grade Level for One Unit of Work.	71
14	Analysis of Variance of Differences Between Sex and Grade Level Groups.	72
15	Analysis of Means Out of Grade Sequence	73
16	Correlations of Reading and Group Intelligence Test Scores with Units of Information (UI) and Time.	76
17	Grand Means for One Unit of Work and Intercorrelations Among Inquiry Scores.	76
18A	Design of Experiment I.	82
18B	Sample Size for Experiment I	82
19	Analysis of Mean Cumulative Change as a Function of Teaching Method.	84
20A	Design of Experiment II	88
20B	Sample Size for Experiment II	88
21	Analysis of Mean Cumulative Change as a Function of Teaching Environment	93
22	Analysis of Variance and Orthogonal Comparisons for Mean Cumulative Change Scores for Environment Groups.	95
23	A Comparison of Variance for Inquiry on the Last Unit of Work.	96
24	Correlations of Creativity Scores and Inquiry Scores for the First Unit of Work.	97
25	Correlations of Creativity Scores and Inquiry Scores for Mean Cumulative Change for Environment Groups	98

LIST OF FIGURES

Figure **Page**

1 Schematic View of Inquiry Materials: I Am The Mayor. 19

2 Example of the Mayor's Work 21

3 Example of the Mayor's Questions. 22

4 Example of the Mayor's Files: Map of Downtown Tinker. 23

5 Example of the Mayor's Files: Growth Chart for Tinker 24

6 Random Access Inquiry Recorder. 26

7 Carrel: The Mayor's Office 27

8 Front Panel and Subject Side of Carrel. . . . 28

9 Inquiry Recorder. 29

10 Sample Inquiry Record and Derivation of Scores 37

11 Distribution of Number of Sessions for Each Child Who Played Mayor 45

12 Distribution of Total Inquiry Time for Ten Units of Work 45

13 Inquiry Activity of Two Fifth-Grade Boys. 47

14 Distributions of Mean Scores for Ten Units of Work 49

15 Inquiry Activity for Three Groups Differentiated on Inquiry Time. 53

16 Cumulative Mean Scores for Three Groups Differentiated on Inquiry Time. 55

Figure | Page

17 Distribution of Inquiry Time for One Unit of Work. 69

18 Distributions of Scores for One Unit of Work. 70

19 Distribution of Reading and Group Intelligence Test Scores for Subsample (n = 95). 75

20 A Comparison of the Inquiry Activity of Nonexperimental and Experimental Groups. 91

21 Mean Cumulative Changes for Three Environments. 94

SUMMARY

The concept of what can be taught needs to be expanded. Traditionally, the transmission of knowledge has been the one commonly accepted educational objective. Today, however, there are other objectives that are equally important. In the modern world, inquiry skills are as important as knowledge itself because inquiry is the process by which knowledge is gained.

The knowledge necessary to cope with everyday events, to hold a job and to deal with world problems is increasing at a rapid rate. Brute accumulation of experiences, skills, facts, and concepts is not a feasible method for obtaining necessary knowledge. The resolution of this dilemma requires that methods for improving inquiry skills be discovered. Such methods would improve the process by which knowledge is gained so as to increase the probability that people would be able to obtain appropriate knowledge to deal with problems at a time when the problems arise. If it is possible to teach inquiry skills, teaching them should become the important educational objective.

The purpose of this project was to describe inquiry behavior in grade school children and to test for the effect of teaching methods and teaching environments on their inquiry activity. The description of inquiry behavior involved both inquiry score variables and background variables. The teaching of inquiry involved the traditional comparison of teaching methods and the nontraditional comparison of changes in teaching environments. For purposes of designing the task and deriving scores, the inquiry process was differentiated in terms of problem sensitivity, problem formulation, search behavior, and resolution.

Entitled, I Am the Mayor, the materials are presented in four parts: (1) The Mayor's Work simulates the kinds of documents which could typically come across the desk of a mayor of a small city. The work includes phone messages, letters, a newspaper, and reports; some of them directly request the Mayor to make a decision, others do not. Each page is numbered at approximately ten points to allow the student to indicate that he senses some embedded problem. (2) The Mayor's Questions in sets of three are on pages which correspond to the points indexed on the Mayor's Work; should the student decide that he senses a problem at any of these points,

he requests the page indicated. When the student receives a page of the Mayor's Questions, he can choose the kind of information he thinks will be helpful in dealing with the problem. Each question directs the student to a document or an index in a set of files. (3) The Mayor's Files, approximately 250 units of information in 20 files, include calendars, a history, laws, maps, general information, department files, budgets, committee records, council records, growth charts, city plans, and letters. Each student has a main index of the files available so that direct entry is possible, and he is instructed to look at as many units of information as he wants. (4) The Mayor's Decisions are sets of pages with a variety of resolutions from which to choose including the possibility for the student to create his own decision.

The score for problem sensitivity is equal to the number of question pages requested, i.e., the number of sets of questions (SQ). The score for problem formulation is equal to the number of questions used plus the number of times a question is implied by use of the main index, i.e., the number of questions asked (QA). The score for search behavior is equal to the number of file pages used, i.e., units of information (UI). The inquiry activity of each child for each unit of the Mayor's Work was scored for SQ, QA, UI and time spent inquiring. The questions that were investigated in these studies are as follows:

Chapter 3. What does inquiry behavior in elementary school children look like? Are some children more prone to inquire than others? How do inquiry scores relate to each other and to the other variables?

Chapter 4. Do children as they get older tend, in terms of grade level, to have higher inquiry scores? What is the relationship of inquiry scores to differences in sex, reading level, and group measures of intelligence?

Chapter 5. What is the effect of differential teaching methods on inquiry scores? Can movies, programed instruction, or discussion be useful for increasing inquiry activity? Can a learning center environment designed to teach inquiry skills be useful for increasing inquiry activity? What is the differential effect of structure in terms of student direction and teacher direction of the learning center? What is the relationship of measures of creativity to inquiry scores?

The first study included 51 children in fourth, fifth and sixth grade. The children were permitted to work as long as they liked and were told they were done after they had been given ten units of the Mayor's Work. The study demonstrated that it is possible to obtain and describe the inquiry behavior of elementary school children without presenting them with specific problems to solve. Scores for SQ, QA, and UI were obtained and the task was regarded favorably by most of the children. Without encouragement or pressure, the children inquired in forty-minute sessions from two to six days. When viewed over a series of units of work, the scores tended to be stable. The main findings follow: The children studied were all able to sustain an independent inquiry as Mayor of a simulated, small city for ten units of work--until they were told that there was no more for the Mayor to do. The differences among individuals in their inquiry activity varied greatly and could meaningfully be grouped in terms of total time spent inquiring. Grouped on this basis, the groups had characteristically different scores on measures of problem sensitivity (SQ), problem formulation (QA) and search behavior (UI). The scores of the children in the low inquiry group were significantly less variable than the scores of the children in the high inquiry group.

The second study involved 228 children (including the 51 from the first study) in third through seventh grade. The inquiry activity for one unit of work which they all had in common was the focus of the study. It was found that inquiry scores could be obtained for children from third through seventh grade. The scores tended to increase with grade level, but an individual grade level could be very much out of the pattern. The independence of the scores was considered from two viewpoints. The scores were independent of sex difference and intelligence level as measured by a group test; there was evidence for a slight effect of reading level on search and length of time spent inquiring. The scores are highly correlated with each other, but have a degree of independence that makes their individual measurement potentially important.

The third study involved two experiments. Experiment I included 20 children in fifth grade and was essentially a pilot study. The children played Mayor every other day for a total of three inquiry sessions. On the intervening days, groups of four participated in teaching sessions. Teaching was accomplished by a movie, programed instruction, and discussion. Two conditions were tried; one using student preference for teaching method and one without student preference. None of the experimental teaching methods significantly increased inquiry activity. The results were essentially the same as those obtained in the nonexperimental groups in the first study; scores were often highest during the initial inquiry session.

Experiment II included 54 children in fifth grade. Nine groups of six children were constructed so as to be balanced for sex, and initial problem sensitivity and problem formulation scores. Three groups each were then randomly assigned to one of three conditions: a teacher-directed or a student-directed learning center designed to teach inquiry, or to a control group. The children played Mayor (M) and attended their respective learning centers (L) for fifty-minute periods for seven days: M,L,M,L,M,L,M. On each day they played Mayor, they received one unit of the Mayor's Work. The experimental learning center was called a Mayor's Workshop and included short movies, programed texts, large pictures, tape recordings, discussion guides, and copies of the inquiry materials. All of these were organized to focus on problem sensitivity and problem formulation. It was found that environments designed to teach inquiry significantly increased inquiry activity. There was a particularly consistent effect on search behavior scores. No differential effect was found between the teacher-directed and student-directed environments, i.e., for the present study inquiry activity was not a function of structure. This was interpreted as evidence that teacher direction in the learning center was unnecessary for the teaching of inquiry skills. No general relationship, investigated by means of correlation, was found between scores on school administered creativity tests and the measures of inquiry activity.

Given the limits of the particular sample in each case, the following conclusions were drawn:

1. Middle elementary school children when given the opportunity will engage in independent inquiry activity. (Chapter 3)

2. Children can be meaningfully differentiated as to inquiry levels. In concrete terms, on the basis of inquiry time, the higher the

level of inquiry, the more the tendency there is to sense problems, ask questions, and use information before reaching a decision. (Chapter 3)

3. There is not good evidence that the inquiry processes theoretically identified--problem sensitivity, problem formulation, and search behavior--are actually separate processes, but the evidence does argue for continued investigation. They are highly interrelated. (Chapters 3 and 4)

4. Inquiry activity is relatively independent of sex differences, reading level, and intelligence. Grade level, though, has a general overall positive relationship with inquiry scores, i.e., the children in the higher grade levels generally obtain higher inquiry scores. (Chapter 4)

5. Creativity measures and inquiry measures are uncorrelated. (Chapter 5)

6. Specific teaching methods--a movie, programed instruction, and discussion--used for two days between three inquiry sessions in a one week trial--have no effect on inquiry activity. (Chapter 5, Experiment I)

7. An environment designed to teach inquiry--used for three days between four inquiry sessions in a seven day trial--significantly increases inquiry activity. (Chapter 5, Experiment II)

8. For the present study, inquiry activity does not increase as a function of structure in terms of student and teacher direction of a learning center--and this was reinterpreted as evidence that teacher direction for the increase of inquiry activity is unnecessary in the environment. (Chapter 5, Experiment II)

In conclusion, we have found that children will engage in inquiry activity when given the opportunity and that they can be meaningfully differentiated on the basis of the time they spend inquiring. Children who spend more time, see more problems, ask more questions, and use more information. Inquiry scores are highly interrelated; they are relatively uncorrelated with other variables, although they tend to increase with grade level. Finally, a teaching environment can effectively increase inquiry activity--comparably, under teacher direction or student direction.

Chapter 1

INTRODUCTION

Traditionally, teaching is most importantly related to the communication of information about reality and meaning. This traditional starting point was not used here. Learning how to learn what one needs to know was considered to be as important or more important than gaining information as a result of the educational process. This educational objective was originally conceptualized as the need to have learning skills; the meaning has since broadened and for the entirety of the report is referred to as learning to inquire. The concept of teaching included any purposeful effect of a person on other persons. So conceived, teaching includes live communication, recorded communication and the whole learning environment. It seemed plausible that manipulation of the learning environment might allow for the teaching of inquiry.

At the onset of the study, it was thought to be sufficient to broaden the concept of teaching to include programed teaching. The intention was to use recorded communication as a tool for doing research on teaching (Allender, 1967a). Subsequently it became obvious that other facets of the learning environment must also be considered when one is concerned with the teaching of inquiry. For the moment, suffice it to say that what started out as a study of programed teaching for improving learning skills has of necessity been greatly altered. Indeed, as should be considered appropriate for what was an inquiry into the inquiry process, fundamental changes occurred as the study progressed. These changes have led to a focus which can now more exactly be called a study of the teaching of inquiry.

Consistent with the starting points, two central problems guided all stages of the research. With learning to inquire as an educational objective, it was critical to develop measures of inquiry behavior. Viewed as a research problem this required that inquiry activity be observed and measured in order to establish baseline scores, without the introduction of teaching variables. With teaching conceptualized as involving the whole learning environment, it was critical to develop environments that were subject to manipulation. It was necessary to investigate potential teaching methods which could be combined to form an effective learning environment.

Viewed concisely, the purpose of this study was to describe inquiry behavior in grade school children and to test for the effect of teaching methods and teaching environments on their inquiry activity. The description of inquiry behavior involved both inquiry score variables and background variables. The teaching of inquiry involved the traditional comparison of teaching methods and the nontraditional comparison of changes in teaching environments. What started out as a study of programed teaching for improving learning skills has ended up as a study of environments for the teaching of inquiry.

There is a history of concern in education for objectives which are directed toward the improvement of inquiry skills. Cremin's discussion (1961) of progressivism suggests that much of American education has been affected by the ideas of John Dewey. However, in a review of the influence of reflective theory on methods of the teaching of social studies, Metcalf (1963) argued that it has not had a major direct effect. Bruner (1961) hypothesized the importance of approaching learning as an act of discovery. Schwab (1962) discussed the possibility of the study of science as inquiry. Although the Taxonomy of Educational Objectives (Bloom, 1956) was developed in response to inadequacies in testing achievement and evaluation, it reveals concern for several objectives other than the accumulation of knowledge per se, and Jarolimek (1962) proposed the taxonomy as a guide to instruction in social studies. Maybe the strongest evidence of concern for such objectives is the appearance of an article which insisted that there is too much emphasis on the importance of cognitive skills (Ausubel, 1964).

The Taxonomy of Educational Objectives has lent itself to direct application (Furst, 1958; McGuire, 1963), but the work mostly involves the testing of learning. Furst's work is a textbook which discussed the construction of achievement tests. McGuire demonstrates how the Taxonomy can be used to guide research on the evaluation process--but not research on the teaching process. Metcalf (1963, p. 933) argued, "Since Dewey's influence on social studies has been pervasive, research should have been expected to emphasize the testing, clarification, and refinement of his theory. Yet only a few studies have attempted to do so, and the rest cast no light on his, or any other, theory of how a teacher might expect to perform his chief intellectual function, the direction of a process by which to assist students in concept attainment." In a review of curriculum planning, Bowers (1963, pp. 272-273) said, "Given information about the pupil, the learning process, and the complexity of the situational variables, the generalized outcome of education appears to be the development of the intellective process, including the so-called higher mental processes such as thinking, problem solving, and creative thinking . . . ." He concluded, "Little research related to learning outcomes has dealt with the comparative effect of task and method variables on learning." In an article on instruction for critical thinking, Shaver (1962, p. 15) said, "The conclusion that follows, then, from a review of the available research is that while there is some evidence to support the proposition that teachers should specifically teach critical thinking skills, research does not give any firm indication as to the relative effectiveness of various methods of teaching those skills." In their review of research on teaching methods, Wallen and Travers (1963, p. 493) report, "Numerous attempts have been made to design teaching methods which will achieve such varied objectives as critical thinking, creativity, problem-solving ability, and so forth. Such methods have generally been stated in only the vaguest terms largely because knowledge on which they could have been built has been lacking."

The difficulty, I think, has to do with the traditional focus of psychologists and educational researchers on the products of learning. The study of learning throughout the history of psychology has usually focused on animal learning and simple verbal learning in order to facilitate experimentation. From the standpoint of the educator, a student's knowledge has been the sine qua non of learning. However, methods are now being developed for the study of the process by which people gain knowledge. Researchers have begun to show more interest in the process by which people learn the complicated knowledge relevant to everyday life. It was thought that the study of these developing methods would have heuristic value in the design of techniques for the study of inquiry and for the evaluation of teaching that attempted to increase inquiry activity.

Research on problem solving was among the first to focus on the process of acquiring knowledge. Interest in the way in which people solve problems began with Gestalt psychologists earlier in this century (see Scheerer, 1963). Not unexpectedly, researchers interested in problem solving usually were most concerned with whether a particular problem is solved, not with the ways in which it is solved. Often the design of the research was such that only one solution and only one method of solution existed. Most often the problems to be solved were not related to everyday life but were puzzles and games. Even so, it is now recognized that solving such problems requires an open-mindedness which works against thinking within a priori limits. Many problems cannot be solved unless we are able to perceive the elements or the problem itself in an unusual manner. Scheerer thought that sudden shifts of thinking were often involved in good problem solving and that fixation was involved in poor problem solving. The sudden shift is what others have called insight.

The need for shifts in thinking is more easily understood, though, when viewed against a broader notion of problem solving. Consider any situation in which there is an incongruency; there will be many possible paths of action which will lead to reasonable solutions and there will be many poor, inefficient, and wrong paths to take. Shifting between paths, shifting the dimensions of the problem, or changing the way a problem is viewed can often make the difference whether a resolution will be reached. An excellent example of the necessity for shifting was presented by Scheerer in the problem requiring one to construct four equilateral triangles from six straight lines of equal lengths (think about it for a moment); it cannot be done unless one thinks in three dimensions instead of two.

Major impetus was given to the study of process by research on how people attain concepts, particularly by the work of Bruner, Goodnow, and Austin published in 1956. Today a large amount of work is being done under such rubrics as concept attainment, concept formation, concept identification and concept learning. Two of the early concerns were with (1) how people process units of information that are being presented to them and (2) what strategies are used to select units of information from an array in attempting to identify a concept. As an example of the former, subjects can be shown concept cards one at a time and be told as they are being presented whether or not the cards are a part of a concept held by the experimenter. As might be expected, people require different numbers of units of information before they can correctly tell that a concept is "only cards with squares," "any red card," "all cards whose number of borders equals the number of objects," etc. As an example of the latter, subjects can be directed to ask whether cards of their choice are part of the concept. People vary in the particular sequence in which they choose cards one at a time and in the total number of cards it takes before they can correctly identify the concept. Research on concept attainment has helped to begin to uncover the nature of the learning process, but it has been hard to apply in realistic educational settings.

One of the fascinating educational endeavors to cope with the importance of process was carried out in the early sixties partly in connection with the development of the National Board Medical Examinations and partly in connection with a developmental program at the University of Illinois College of Medicine in the Office of Research in Medical Education (Williamson, 1965; McGuire & Babbott, 1967). Examinations were constructed which allowed the student to practice medicine on simulated patients. Called Patient Management Problems, the student first reads about his patient's problems and then is required to choose the dimensions along which he wants to find information. He does this by erasing a plastic coating covering the directions of where he is to proceed for any given dimension, e.g., hospitalization, physical examination, laboratory tests, etc. He proceeds to other sections of the examination where he can collect data, much like the subject who asks about units of information in a concept attainment task. The examination was not created as a research tool, but it more than sufficiently serves to demonstrate open-ended possibilities for applying ideas from research on concept attainment and problem solving.

However, the learning tasks in studies related to cognitive processes are usually designed to facilitate experimentation and the direct application to realistic subject matter is difficult. For example, in their research on concept attainment, Bruner et. al. (1956) used cards with differing shapes, colors, and number of shapes, colors and borders, and Podell and Carter (1963) used nonsense words and geometrical figures. For research on problem solving, Rokeach (1960) reported on the use of an imaginary "doodlebug," and Scheerer (1963) discussed the use of puzzle-like problems. Many of the tasks used by Rimoldi and Devane

(1961), and Rimoldi, Fogliatto, Haley, Reyes, Erdmann, and Zacharia (1962) for teaching problem solving skills involved geometrical figures. A notable exception is contained in the work of Suchman (1961 and 1962). With short silent films of science laboratory demonstrations, Suchman's methods increased the number of questions children generate to help themselves understand and explain the phenomena portrayed.

In response to the general problem, Shulman (1963 and 1965) proposed a conceptual framework and a method for examining inquiry behavior. He pointed out that the tasks that have been typically used do not allow for the simulation of a natural inquiry situation. This is mainly because the tasks always present a given problem to be solved, unlike what goes on in the world outside the laboratory. Although focusing directly on inquiry training, Suchman's research still only allowed the student to formulate the questions he will ask or to select the data he chooses to know. There seemed to be no technique which required the student to select those situations which seem incongruent to him. Such a task would allow the student to ferret out situations which are problematic to him; the ability to do so is what Shulman called problem sensitivity.

Shulman theorized that it was necessary to view inquiry behavior simultaneously in terms of problem sensitivity, problem formulation, search behavior and resolution behavior. He argued, "A 'problem' is defined as a situation combining two components: (1) an existential state of ambiguity or incongruity, embodying an indeterminancy that characterizes the objective components of the situation, rendering the situation itself somehow 'questionable,' in Dewey's terms, and which we call the 'potentially problematic situation,' and (2) the subject, sensing the indeterminancy of the situation, and perceiving it as, for him, problematic" (1963, p. 14). He defines the inquiry process as initiated when an individual senses that a situation of which he is a part is somehow problematic. It is focused when the individual then formulates for himself the nature of the problem and thus sets it in a context which both directs subsequent actions and delimits their scope. It is a form of action when the individual engages in search activities in order to gather data bearing upon the problem and, possibly after reformulation and additional search, arrives at a state of resolution in which the problem-as-sensed is perceived as resolved.

In order to have a task which would simultaneously allow a subject to sense problems, formulate the kinds of data needed to solve the problems and then search for that data, Shulman developed the Teacher's In-basket. He modeled the in-basket after an earlier one developed in the late fifties for administrators (reported in detail by Hemphill, Griffiths and Frederiksen, 1962). Unique to the Teacher's In-basket is the possibility for subjects to exhibit problem sensitivity; this is accomplished by embedding potential problems. The subject is asked to play the role of a teacher. The situation is that of a teacher who has taken over a class in the middle of the year. It is the first day for the teacher and there are no students because it is a record day. An in-basket on the desk contains items such as phone messages, memoranda, newsletters, and information that could possibly be found about the children in an actual classroom. In addition to the contents of the in-basket are sets of records: report cards, achievement and aptitude records, the attendance book, anecdotal records, and the cumulative record folders. An intercom allows the subject to talk to the "secretary." The subject is required to think out loud and is viewed through a one-way glass. Two observers busily record the units of material that are attended to, the embedded problems that are sensed, the different kinds of information sources that are used, and the time spent inquiring. Shulman has thus far been able to demonstrate that inquiry behavior is quantifiable even though his subjects do not have specific problems to solve. In a study of teacher trainees, he found that inquiry measures correlate meaningfully with some simple paper and pencil measures of cognitive behavior such as willingness to take risks in a test situation and the ability to name a variety of uses for simple objects. Looking at two polar groups of subjects on the basis of these cognitive measures, he found that those persons who theoretically ought to be the more open and active inquirers indeed had significantly higher scores on problem sensitivity and time spent inquiring. These same inquiring types processed units of information more slowly than their opposites--they spent more time with each unit of information at which they looked.

The interest of the investigator was to develop a similar technique that could be used in teaching inquiry skills to children. Initially the intent was to develop a situation which was based on an inquiry model which had been proposed by Miller, Galanter, and Pribram (1960). They theorized that an organism's behavior was based on test-operate-test-exit units which they called TOTEs. On the basis of their model, materials were needed which would allow children to test for incongruencies and to have available a set of data on which they could operate. Exiting would consist of deciding on some resolution to the incongruency to which they had chosen to respond.

This model was consistent with Shulman's actual measurement procedures. Both discussed formulation as an important aspect of process; neither approach, though, successfully isolated it as a separate function. For Shulman, problem formulation is reflected in the number of different information sources used by a subject, but the measure is clearly confounded with search behavior scores. Consistent with the findings from the research on problems solving, formulation needed to be reflected in the dimensions along which a person would choose to look for data. For the present study, it was decided, therefore, that it was necessary to have four interconnected kinds of materials. The use of the first would reflect the recognition of incongruency, testing in the TOTE model. The use of the second would reflect changes going on inside the organism, formulating. The use of the third would allow for a direct measure of search behavior, operating. The fourth would consist of resolutions, exiting. In the following chapter, operational definitions will be made for corresponding measures of inquiry activity: problem sensitivity, problem formulation, and search behavior. Differences in scores obtained with these measures are considered for this study to reflect differences in inquiry behavior. Increases in these scores are considered to reflect learning.

Planning for the teaching of inquiry suggested that the concept of what could be taught and how to teach could be expanded by redefining the meaning of teaching. A necessarily acceptable definition of teaching at a very basic level is to say that a person or some people communicate carefully collected information about the nature of reality and meaning to some other person. The person who receives the communication changes in some way although the change may be imperceptible. This person will be better able to understand and thereby manipulate reality to his advantage and to the advantage of the people around him.

Successful teaching by this definition results in educated men. It is possible, in a small way, to teach inquiry skills in this manner. Man has had an abundance of experience in the business of research and philosophical inquiry. This experience can be communicated as a body of information, For example, a good way to solve a problem is first to define it carefully, then to hypothesize solutions, and then to test the solutions by some empirical means. Another possiblility for teaching inquiry consistent with this definition would be to teach what few concepts are known about the inquiry process and then let the students practice inquiring. For the remainder of the "teaching" of inquiry, the student could then be left to do what he pleases to do. In the final analysis, it seems that students must be allowed and encouraged to inquire independently. But there can be more to the teaching of inquiry when the definition of teaching is not limited to the communication of information about reality and meaning.

It is reasonable, I propose, to define teaching in terms of any purposeful effect of one person or persons on others. It is usually thought that effective teaching must involve the communication of particular knowledge. Ordinarily, some knowledge would have to be imparted or at least the student would have to be told he is doing the right or the wrong thing. At the very least, it is thought that the teacher's behavior, attitudes, or values ought to be implicitly communicated so that the student might emulate them or allow them to be an object of identification. In contrast, this definition includes the idea that the teacher might only plan the student's environment. Recent developments in the use of audio-visual recorded communication allow for the possibility (Allender, 1967a).

If we want to teach, we must agree that there will be a need to have an effect on others, i.e., the students. We must also agree that there is a need in the modern world to help students to learn to inquire. These two needs are a source of conflict in general and particularly for the teacher. The need to affect others is a more abstract way of pointing out the importance of teaching man's collected knowledge for the benefit of the new generations. The need to allow for individual inquiry is a more abstract way of saying we believe that every person ought to be able to develop in a manner which gives him an ability to determine and guide the course of his own life. Teaching, by any useful definition, will often come into conflict with individual inquiry. They may be fundamentally in conflict with each other. It would seem then that a definition of teaching which would minimize the conflict would be important. Teaching which only involves the planning of the students' environment is therefore important because it minimizes potential conflict between the teacher and the student.

In the following chapter, the specific teaching methods used in this study will be presented and how they were arranged to constitute a teaching environment will be discussed. In general, live and recorded teaching sequences were developed to teach problem sensitivity and problem formulation. The main differences among teaching environments were created by changing the degree to which students could determine how and when they would be taught. Minimization of the conflict between student and teacher was defined as being effected by increases in the degree to which students could determine the manner of teaching.

For some studies, it would be appropriate at this point to state the main questions that the investigation set out to answer. For the present study, the original questions and the actual questions are sufficiently different so as to make repetition of the former of little value. The research reported here took place over a period of more than two years and is presented as three individual, although related, studies. The general characteristics of inquiry behavior were investigated in the first study for fourth, fifth, and sixth grade children. The main goal was to look for differences in inquiry behavior and to compare the results with those obtained by Shulman (1963 and 1965). In the second study, the possibility of developmental trends was investigated for children in third through seventh grade. Taken together, the first and second studies were viewed as baseline data on inquiry activity for grade school children--no experimental treatments were introduced as independent variables. The only independent variables considered were descriptive: grade, sex, intelligence, reading level, and time spent inquiring. The effects of teaching methods and teaching environments were investigated in the third study for fifth grade children. In a pilot experiment, programed instruction, discussion and a movie were used to test for their effect on inquiry scores. The main part of the study involved an investigation of the effects of two different teaching environments on inquiry activity. Individual teaching methods were all made simultaneously available in a learning center run under the conditions of student direction and teacher direction.

In summary, this research represents an effort to obtain a description of inquiry behavior in grade school children and to determine whether and under what conditions inquiry activity can be increased.

Chapter 2

METHODS[1]

In the present chapter, the inquiry materials, the measurement procedures, the teaching materials, and the general design are described. The specific aspects of the method related to each particular study are discussed in the appropriate sections.

Inquiry Materials

Most critical to the research was the development of materials that would allow for inquiry activity in elementary school children. As part of the development of methods for the study of search behavior in children, Donna Allender and the investigator wrote a set of inquiry materials called I Am the Mayor (Allender & Allender, 1965).[2] The materials allow a child to test for incongruencies, to formulate plans of action, to search for information and to make decisions--and at the same time allow for direct measures for deriving inquiry scores. Out of pure invention together with the fact that young children study community life as part of social studies, a situation was constructed where a child could play the role of mayor of a small city. Satisfying the demands of the theoretical considerations presented in the first chapter, the materials written consist of the following four sections: (1) The Mayor's Work includes 10 documents which could cross the desk of a mayor of a small city. (2) The Mayor's Questions include about 80 pages of multiple-choice formulations of potential problems. (3) The Mayor's Files include approximately 250 pages of data regarding general information, departments, current business, and correspondence. And (4) The Mayor's Decisions include about 30 pages of possible decisions. A schematic view and interconnection of the sections of the materials is shown in Figure 1. The arrows represent some of the possible movement following from unit of work 100.

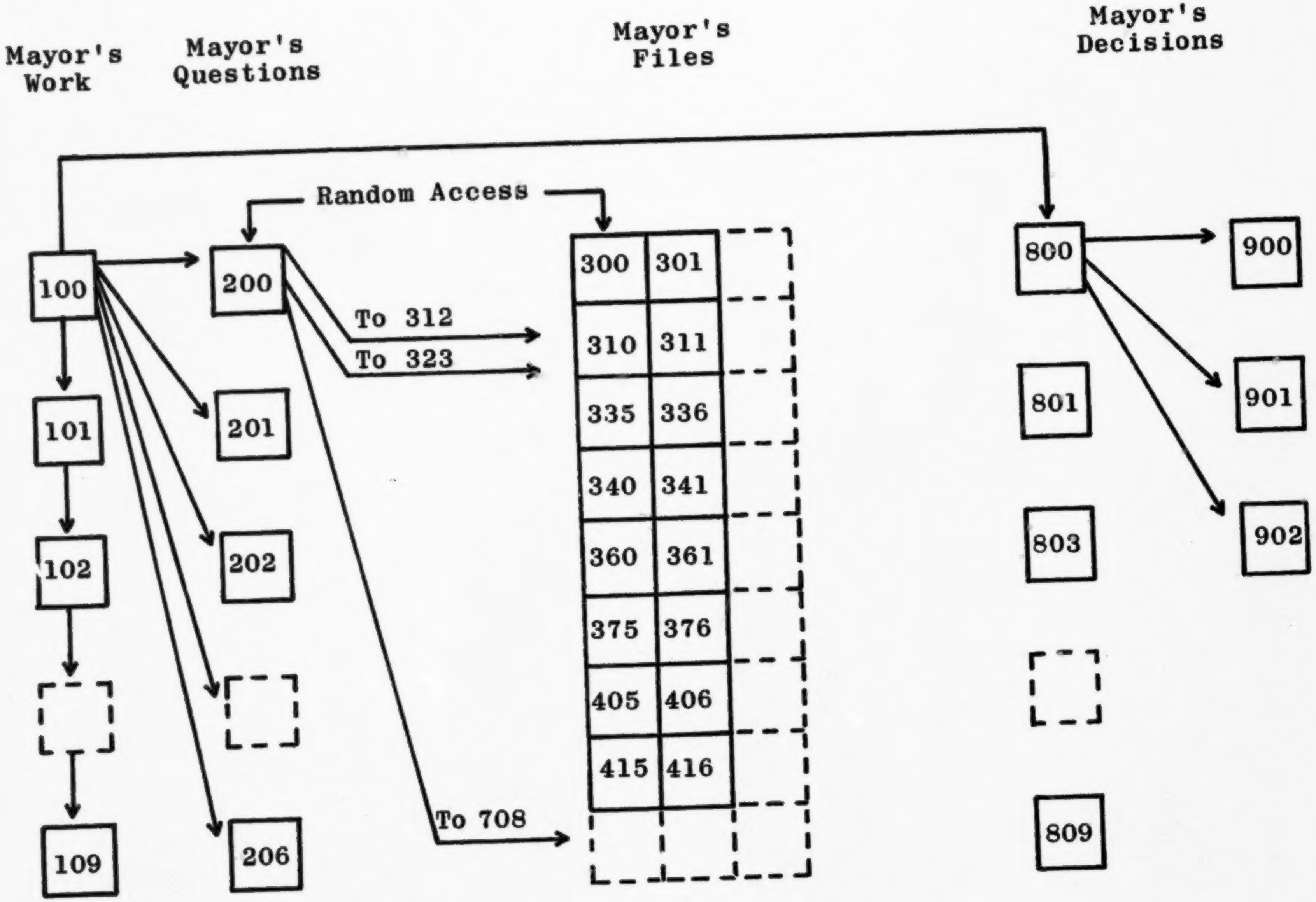
---

[1] Parts of this chapter were presented in a paper at the American Educational Research Association meeting, New York, February, 1967, entitled "Problem sensitivity in elementary school children."

[2] This research was supported by a grant from the Miami University Faculty Research Committee.

FIGURE 1

SCHEMATIC VIEW OF INQUIRY MATERIALS: I AM THE MAYOR


Mayor's Work
Mayor's Questions
Mayor's Files
Mayor's Decisions
Random Access
100
101
102
109
200
201
202
206
To 312
To 323
To 708
300
301
310
311
335
336
340
341
360
361
375
376
405
406
415
416
800
801
803
809
900
901
902

Note: Boxes represent pages. Illustrative numbers correspond to actual page numbers.

The Mayor's Work simulates the kind of documents which could typically come across the desk of a mayor of a city of about 12,000 people (Figure 2). The Mayor's Work includes letters, telephone messages, a local newspaper, and reports. Some of the materials directly request the mayor to make a decision; others do not. To allow a student to indicate that he perceives a problem for himself, each page is numbered at several points, often as many as ten. The student is instructed to request a page of The Mayor's Questions relating to the point indexed whenever he feels there is some question that ought to be asked. Should the student decide that he sees a problem at any of these points, he can request the page indicated. Every time the student turns to a page of The Mayor's Questions, he is able to choose the kind of information he thinks will be helpful for his problem or question (Figure 3). The student is there directed to The Mayor's Files.

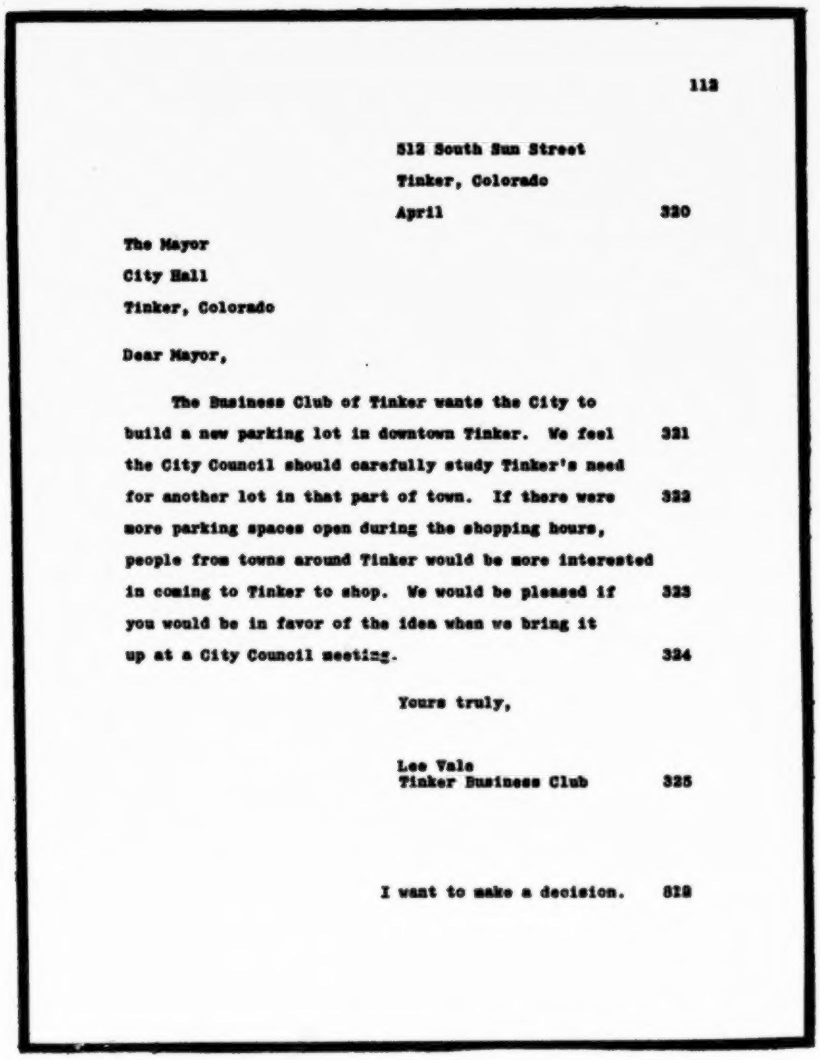
The Mayor's Files include calendars, a history, laws, maps, general information, department files, budgets, committee records, council records, growth charts, city plans, and letters (Figures 4 and 5). Each student has a general index of the files available so that direct entry to the files is possible and he is instructed to look at as many units of data as he wants. At any time, he may return and consider The Mayor's Questions or his work. The Mayor's Decisions are sets of pages with a variety of resolutions from which to choose including the possibility for the student to create his own decision. Appendix A includes a complete set of examples.

Measurement Procedures

The in-basket met the requirements for a natural inquiry situation specified by Shulman (1963, see Chapter 1), but there were several changes that needed to be made in his techniques for data collection before it could be used as a research tool for working with elementary school children. The requirement to think out loud seemed to be a difficult burden to impose on young subjects. The reliability of his data collection methods was not always as high as would be ideal; the problem seemed as if it would be more severe when observing children. And the need for a one-way glass required that the research only be carried out in the laboratory leaving out any possibility for trial implementation in school settings.

FIGURE 2

EXAMPLE OF THE MAYOR'S WORK



112

512 South Sun Street
Tinker, Colorado
April 320

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

The Business Club of Tinker wants the City to
build a new parking lot in downtown Tinker. We feel 321
the City Council should carefully study Tinker's need
for another lot in that part of town. If there were 322
more parking spaces open during the shopping hours,
people from towns around Tinker would be more interested
in coming to Tinker to shop. We would be pleased if 323
you would be in favor of the idea when we bring it
up at a City Council meeting. 324

Yours truly,

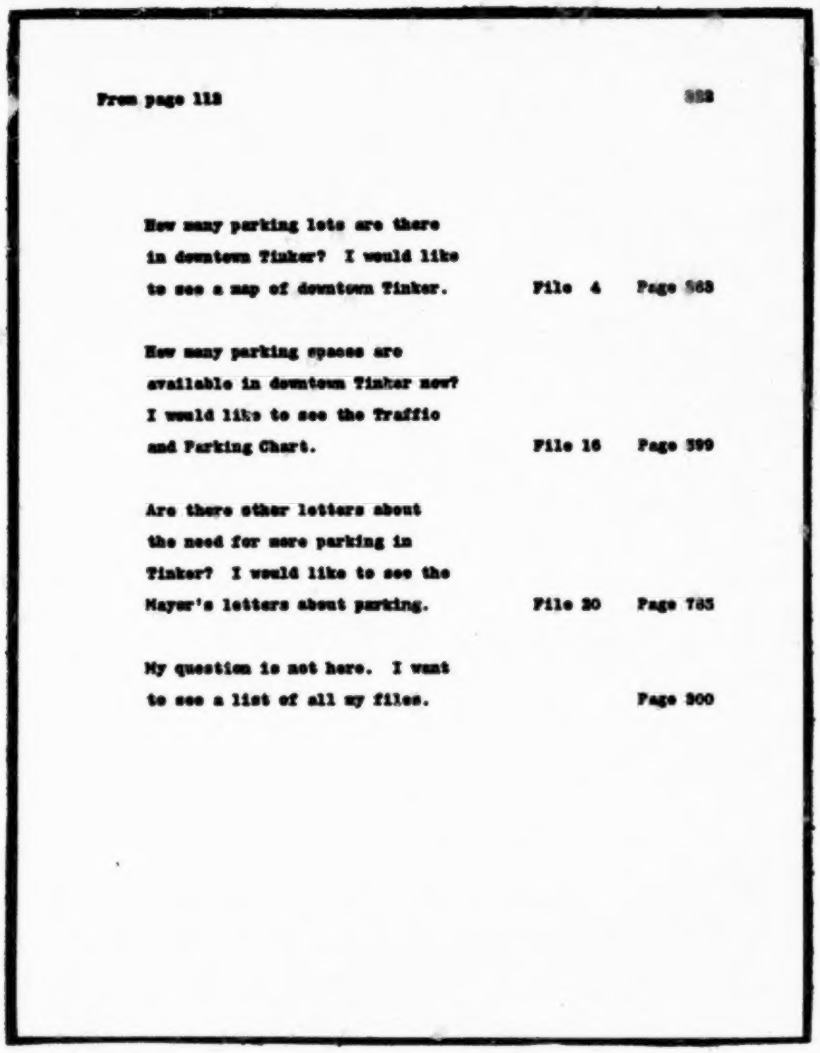
Lee Vale
Tinker Business Club 325

I want to make a decision. 812

Note: The Mayor's Work consists of ten documents similar to the one above. The student indicates that he senses some problem for himself by choosing as many of the question pages as he wants to see. These pages are indicated to him by the numbers in the right hand margin.

FIGURE 3

EXAMPLE OF THE MAYOR'S QUESTIONS



From page 112 332

How many parking lots are there
in downtown Tinker? I would like
to see a map of downtown Tinker. File 4 Page 563

How many parking spaces are
available in downtown Tinker now?
I would like to see the Traffic
and Parking Chart. File 16 Page 399

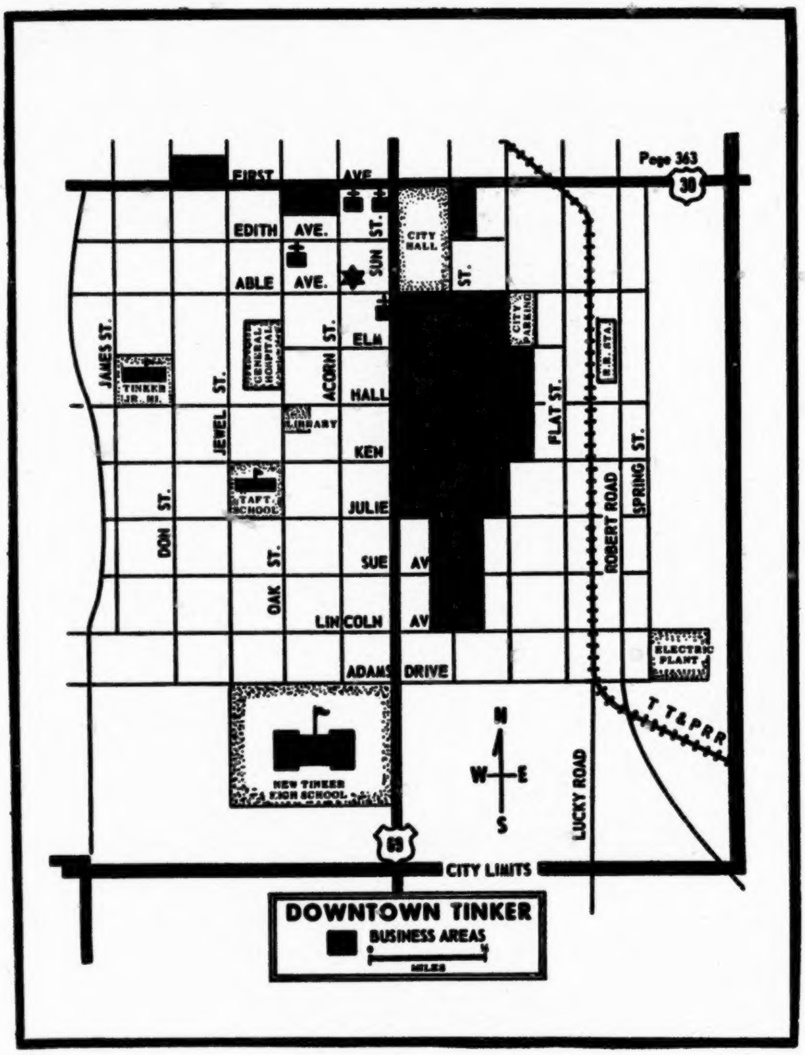
Are there other letters about
the need for more parking in
Tinker? I would like to see the
Mayor's letters about parking. File 20 Page 785

My question is not here. I want
to see a list of all my files. Page 300

Note: The Mayor's Questions consist of about 80 documents like the one above. The student can choose one of the formulations provided or develop his own by using the general index of the files.

FIGURE 4

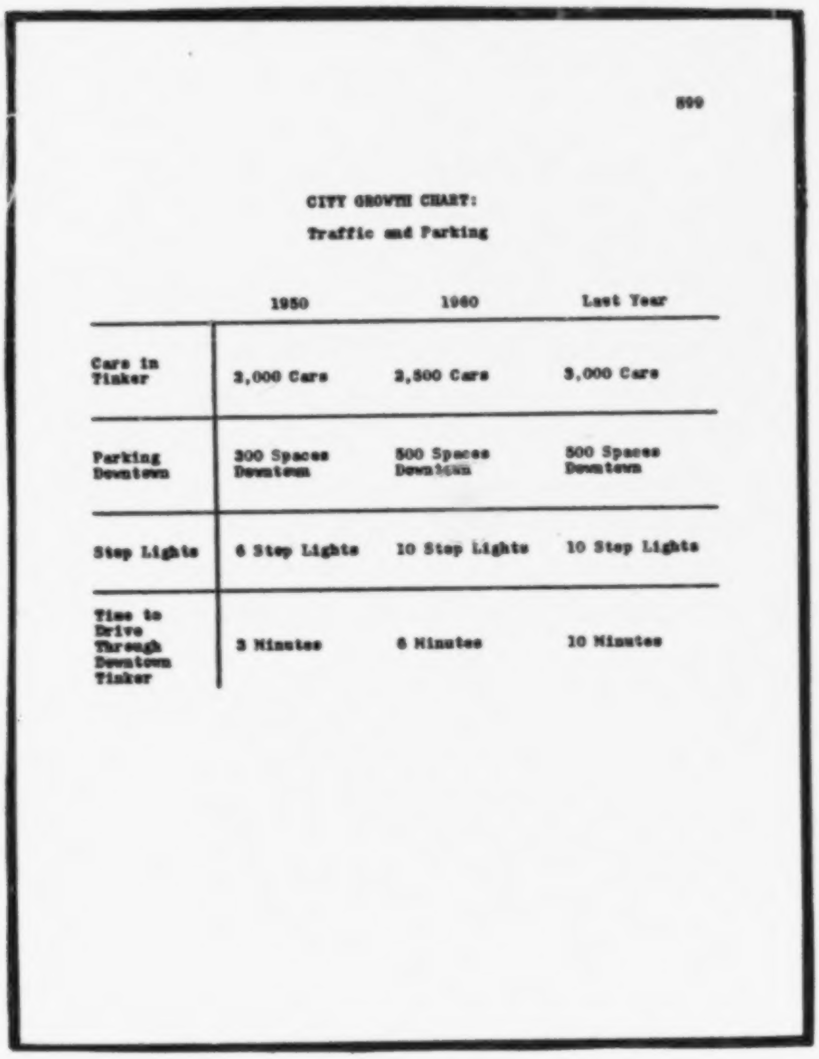
EXAMPLE OF THE MAYOR'S FILES: MAP OF DOWNTOWN TINKER


Page 363
30
FIRST AVE
EDITH AVE.
ABLE AVE.
SUN ST.
CITY HALL
ST.
CITY PARKING
R.R. STA.
JAMES ST.
TINKER JR. HI.
JEWEL ST.
GENERAL HOSPITAL
ACORN ST.
ELM
HALL
LIBRARY
KEN
FLAT ST.
TAFT SCHOOL
JULIE
DON ST.
ROBERT ROAD
SPRING ST.
OAK ST.
SUE AV
LINCOLN AV
ADAMS DRIVE
ELECTRIC PLANT
T T&P RR
NEW TINKER HIGH SCHOOL
N
W
E
S
LUCKY ROAD
69
CITY LIMITS
DOWNTOWN TINKER
BUSINESS AREAS
MILES

Note: This map (printed in three colors) is one in a file of ten maps available to the Mayor. (Copyright information is on the first page of Appendix A.)

FIGURE 5

EXAMPLE OF THE MAYOR'S FILES: GROWTH CHART FOR TINKER



809

CITY GROWTH CHART:

Traffic and Parking

	1950	1960	Last Year
Cars in Tinker	2,000 Cars	2,500 Cars	3,000 Cars
Parking Downtown	300 Spaces Downtown	500 Spaces Downtown	500 Spaces Downtown
Stop Lights	6 Stop Lights	10 Stop Lights	10 Stop Lights
Time to Drive Through Downtown Tinker	3 Minutes	6 Minutes	10 Minutes

Note: This chart is one in a file of nine charts available to the Mayor. (Copyright information is on the first page of Appendix A.)

Work done earlier in medical education at the University of Illinois (Allender, 1964) led heuristically to the final conception of the materials. The work involved experiments designed to evaluate programed teaching. It was determined that it would be possible to approximate the process by which a set of instructional materials were used if an instrument were available which could provide data on what units of information were being viewed, the time spent viewing them, and the sequence in which they were viewed. A unit could vary in size from a single word to a long descriptive lesson, each unit could be numbered, and the numbers could easily be coded to differentiate kinds of information being used. The ideal instrument, not yet economically feasible, was a computer terminal capable of individually presenting materials to students. Several unsuccessful attempts were made to construct random access microfilm recorder devices which could sufficiently simulate a computer terminal to provide the basic data and be practical to build. One operating prototype (diagrammed in Figure 6) was designed and built by George Luhr, head of the Instrument Shop, and the investigator in connection with research done in the Office of Research in Medical Education at the University of Illinois College of Medicine. No commercial manufacturer was subsequently found who would be willing to build and perfect a similar recorder for the present research. Out of this situation, two more practical data collection instruments were developed.

Because the original intention to build a random access device resulted in the rejection of several prototypes, it was decided to change the design radically. One goal was to build a device that could be immediately useful for the present research and another goal was to develop a semi-automatic device that would function as an inquiry recorder for future research on the inquiry process. To accomplish the first goal, an experimenter and a study carrel were used to simulate the simulator (see Figures 7 and 8). To accomplish the second goal, knowledge gained from the experience of building the earlier devices and from the ongoing use of the carrel was combined to create a device critically simpler than those built previously (see Figure 9).

The resulting inquiry recorder is an ordinary microfilm reader modified to include a four column punch card reader connected to a data collection system. The recorder can be built in an ordinary instrument or machine shop for under $2,000; detailed information with regard to its

FIGURE 6

RANDOM ACCESS INQUIRY RECORDER

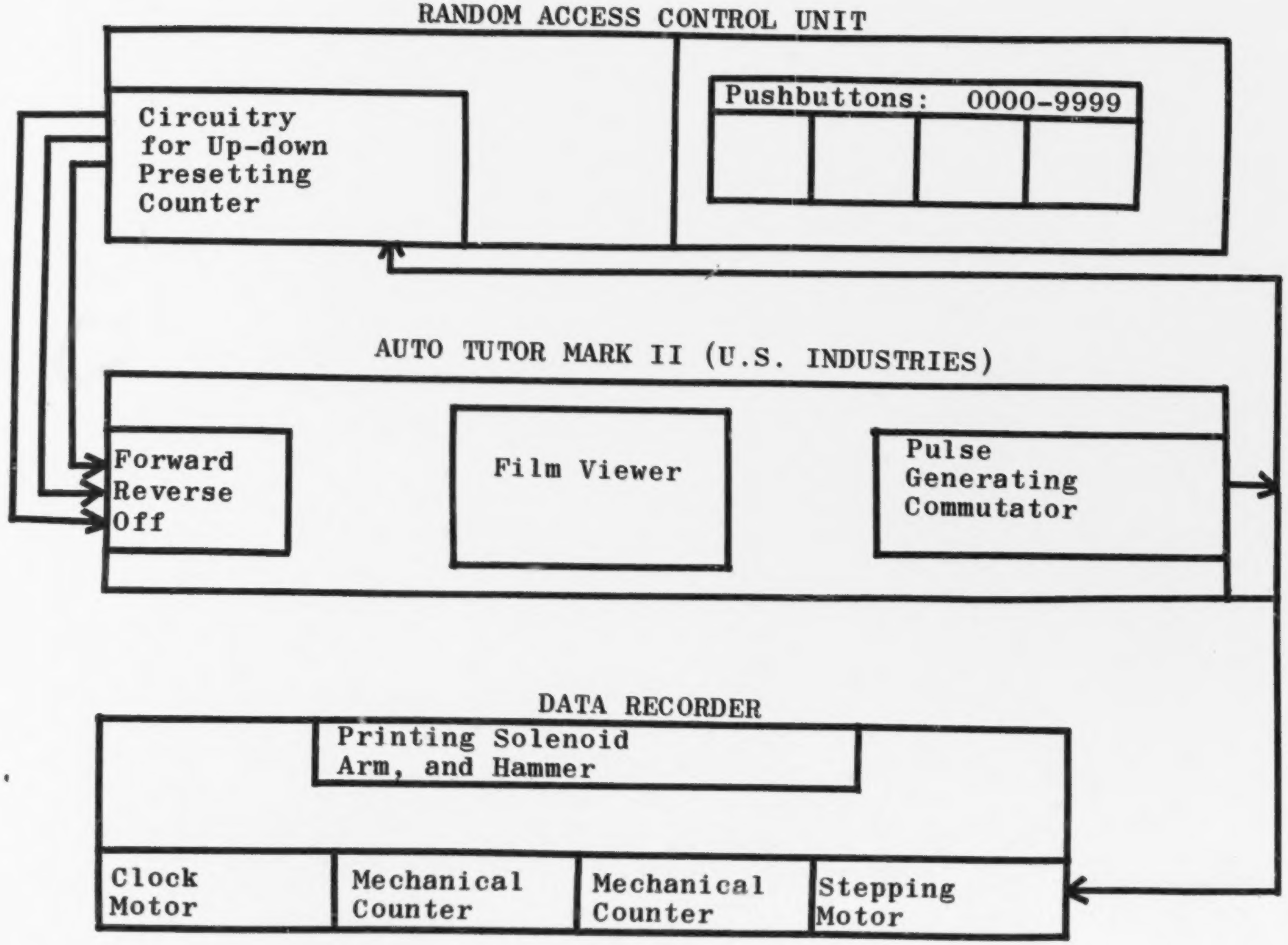

RANDOM ACCESS CONTROL UNIT
Circuitry for Up-down Presetting Counter
Pushbuttons: 0000-9999
AUTO TUTOR MARK II (U.S. INDUSTRIES)
Forward Reverse Off
Film Viewer
Pulse Generating Commutator
DATA RECORDER
Printing Solenoid Arm, and Hammer
Clock Motor
Mechanical Counter
Mechanical Counter
Stepping Motor

FIGURE 7

CARREL: THE MAYOR'S OFFICE

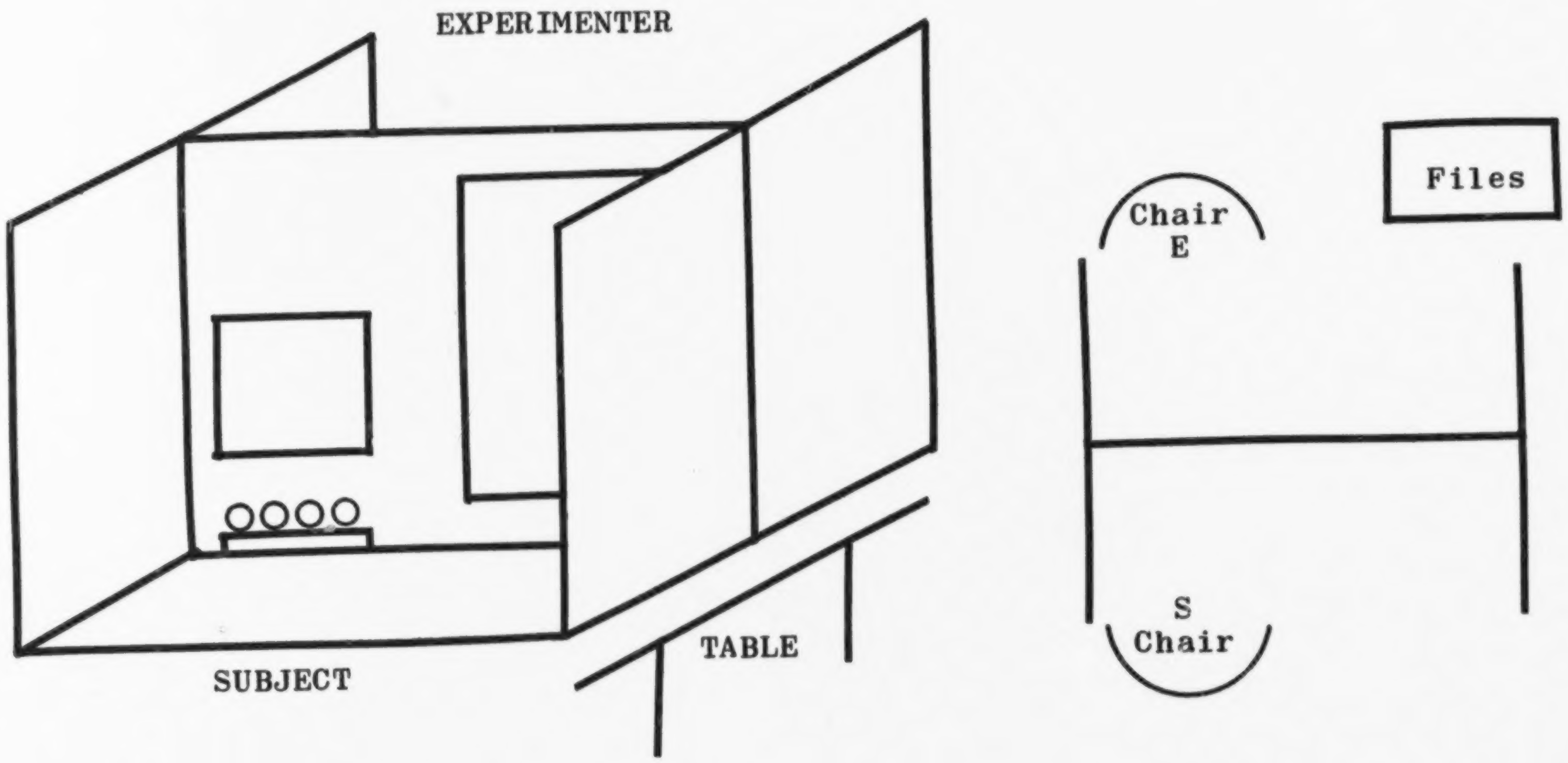

EXPERIMENTER
SUBJECT
TABLE
Chair
E
S
Chair
Files

FIGURE 8

FRONT PANEL AND SUBJECT SIDE OF CARREL

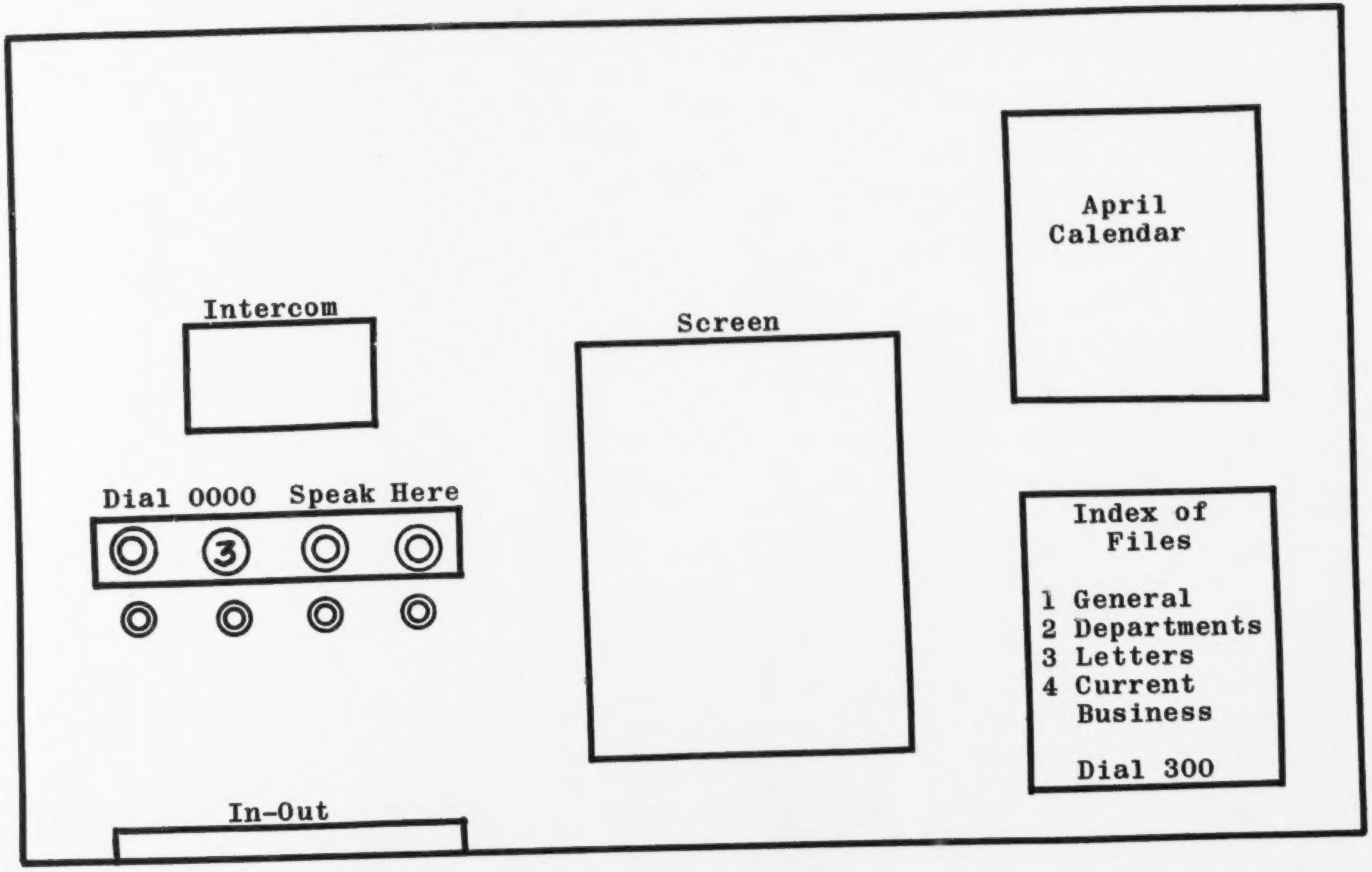
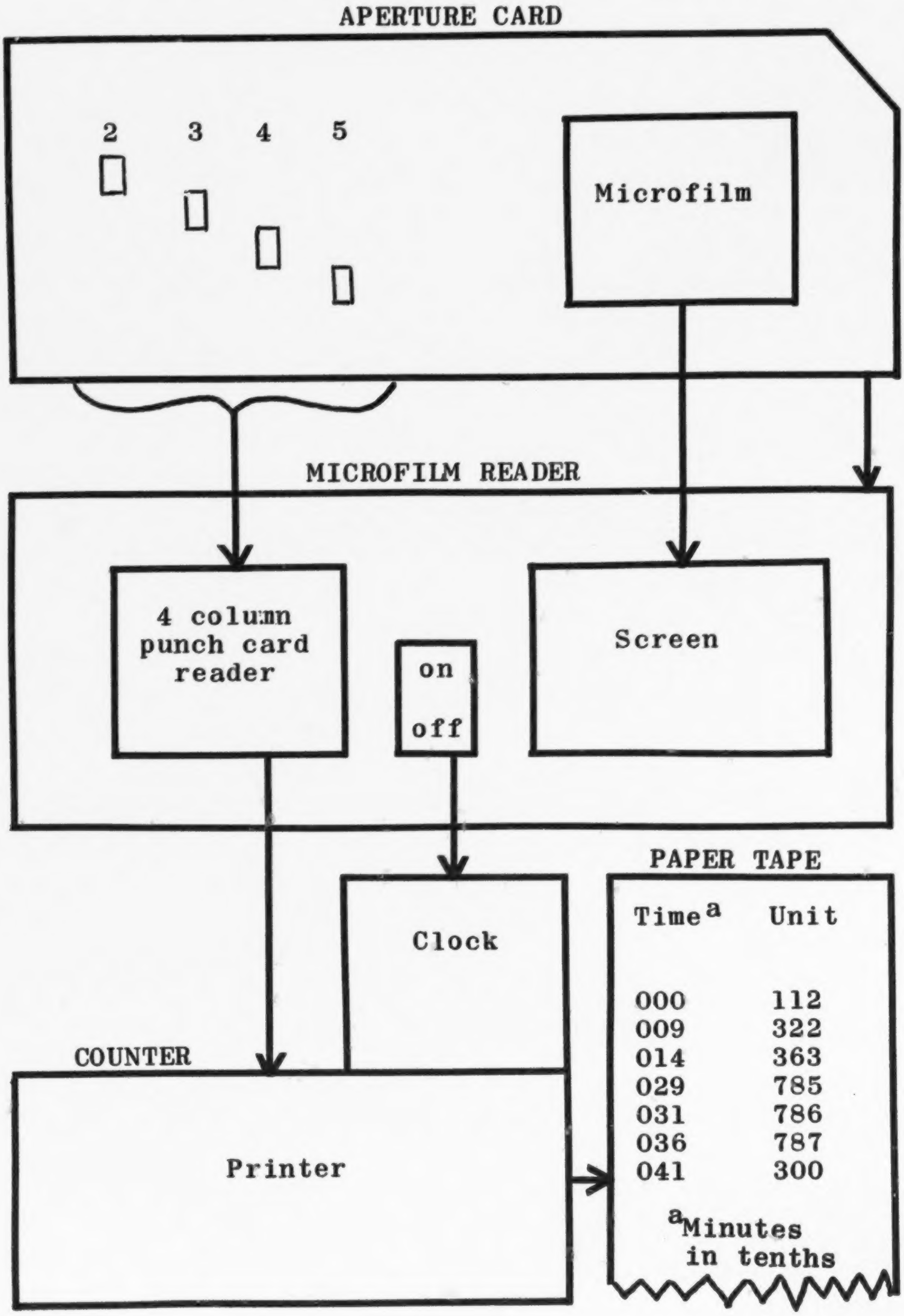

April
Calendar
Intercom
Screen
Dial 0000
Speak Here
3
Index of
Files
1 General
2 Departments
3 Letters
4 Current
Business
Dial 300
In-Out

FIGURE 9

INQUIRY RECORDER


APERTURE CARD
2
3
4
5
Microfilm
MICROFILM READER
4 column punch card reader
on
off
Screen
PAPER TAPE
Clock
COUNTER
Printer

Time[a]	Unit
000	112
009	322
014	363
029	785
031	786
036	787
041	300

[a] Minutes in tenths

construction and operation are presented in Appendix B. Critically different than previous models, it uses aperture cards instead of rolls of film; the random access function is deleted and the student is expected to find the documents he wants to view in his own file. Except for the card punch reader, the control center, and the on-off switch, the components are of standard manufacture. There are a minimum of moving parts and, thus far from the use that has been made since its completion, it has proved to provide an almost perfect record of the units viewed, the sequence of units and the time spent viewing them.

The carrel is constructed of lightweight plastic-foam filled cardboard and covered with paper with a brown wood panel pattern. The subject side of the carrel includes a "picture of the town", "the state seal", and a name plate with the subject's name under the title, "Mayor." The students were introduced to the carrel as "The Mayor's Office." An experimenter functions as inquiry recorder simply by finding the page requested by the subject and at the same time recording what page was requested and the amount of time it was viewed. From the point of view of the students, the experimenter is the mayor's secretary. The students dial the page number of any page they want to retrieve. The page of the files is shown on the screen; the work and question pages are given to the students through the in-out slot; the "intercom" is used when the student wants to ask a question or to give him special instructions.

As a final note with regard to the recorder and the carrel, it must be pointed out that the functions they perform are not totally the same. The carrel has been particularly useful in these early stages of research on inquiry processes for whenever difficulties encountered by the subjects were not anticipated, an experimenter was present to answer and record questions. A corresponding disadvantage has been the students' dependence on their secretary-experimenter. It was intended that applications of the inquiry materials in a regular school program could eventually be studied in future research; it is thought that the inquiry recorder will facilitate such research. All of the research reported in the following studies utilized the carrel for the data collected.

Teaching Materials

In addition to the inquiry materials, two programs were developed by Donna Allender, one for teaching problem sensitivity and the other for teaching problem formulation. Each program was prepared for three different teaching methods, including a short movie, a programed text, and a planned discussion. The central idea of the problem sensitivity programs was to show that many seemingly unproblematic situations contain embedded problems worthy of investigation. The central idea of the problem formulation programs was to show that many different questions can follow from any given sensed problem. The movie, the text, and the discussion plan all covered approximately the same content. To insure their similarity, many of the illustrations and examples used were identical. All were planned to be usable within a single presentation period (40 to 50 minutes). The six synopses follow:

1. Problem Sensitivity Movie (approximately 11 minutes). The first part shows a series of pictures of absurd incongruencies with the comment, "What's wrong?" The pictures include bananas growing in the ground, a dog in a tree, a car in a tree, a teeter-totter with both ends up, a house with a tree growing out of its chimney, kite strings going up without kites at the end, a house in the middle of a body of water, ski tracks going around two sides of a tree, a piano with only white keys, a map of the United States marked Canada, a light switch that doesn't work, a telephone call without a caller, and stairs that seem to go nowhere. The second part of the film shows a series of obviously problematic social situations. The first one is about a child who offers to pay for ice cream for a friend and then discovers the money he thought he had is lost. The second one is about a woman who is unable to find spark plugs for a 1939 model of a car. The third one is about a child who finds a coupon offering free books and another child who points out the small print. The fourth one is about a child who gets in trouble in school. The third and last part presents four letters with embedded problems to a mayor (see Appendix C, Letters 1-4). The letters are about a crowded swimming pool, adequacy of bus service, adequacy of garbage collection, and an increase in local taxes. After the letters are read a pointer indicates potential problems. The point of the movie is to give the student a feeling for the potentially problematic situation by moving from

the absurd, to possible and obvious problems, to problems created mainly by the lack of complete information in the situation.

2. Problem Formulation Movie (approximately 23 minutes). The first part reshows some of the absurd pictures from the problem sensitivity movie, with the comment, "What do you think?" Each is followed by possible explanations pictured in a similar fashion but with more detail or from a different point of view. The second part reshows part of three of the problematic social situations and continues them by raising questions about the previously uncovered problems. Places where lost money might be are suggested, specific difficulties buried in small print are discussed, and several very different aspects of "to get in trouble in school" are brought out. The third part presents three of the letters from the problem sensitivity movie and raises questions about potential problems in each. With regard to the crowded swimming pool, questions of meaning are raised by showing pictures like that of many people in a pool and no one on the sides, no one in the pool and many people on the sides, a very small pool, and many people in only one part of an ordinary sized public pool. With regard to the adequacy of bus service, questions are raised by portraying widely different running schedules and degrees of overcrowding. For the letter on local taxes, questions are raised with regard to kinds of taxes, amounts and sources of increase, and kinds of city services possibly effected. The point of the movie is to demonstrate what it means to formulate questions for potentially problematic situations.

3. Problem Sensitivity Programed Text (branched, 36 pages). The text begins with two questions: "What is a problem?" and "How do you feel when you sense a problem?" Following the questions are simple situations and the opportunity to recognize obvious problems. They include someone's missing a school bus, bananas growing in the ground, a mixed up sentence, an ambiguous note, and missing lunch money. The second part of the text presents questions with regard to problems in the letter about the adequacy of garbage collection and in the letter about an increase in local taxes (See Appendix C, Letters 3-4). The tax letter is presented similar to the way in which letters are set up in the inquiry materials; a page number follows each sentence of the letter. The student is instructed to choose those sentences in which he thinks problems are embedded and on each of the corresponding pages is a discussion of the likelihood of there being a potential problem. The last part of the text uses one

of the letters from I Am the Mayor (See unit 100 in Appendix D). The discussions are set up in the manner of the letter on taxes. The point of the text is to help the student to become aware of possible problems.

4. Problem Formulation Programed Text (branched, 55 pages). The text begins with the question, "What's wrong?" and the student is instructed to think of possible things that could be wrong by asking questions. The situations of a student missing a bus, bananas growing in the ground, and a game without directions are presented, and for each situation, the student is helped in the asking of a variety of possible questions that would clarify the situations. The second part of the text uses the letter about an increase in taxes. A set of questions is presented for each sentence in the letter and each question is followed by a page number. On each of these pages, the utility of the question is discussed. The student is directed to choose questions that he feels are important or simply interesting and to read the corresponding discussion. The third part of the text uses the same one of the letters from I Am the Mayor used in the problem sensitivity programed text. The discussions are set up in the manner of the letter on taxes. The point of the text is to help the student formulate a wide variety of questions for potentially problematic situations.

5. Problem Sensitivity Discussion Plan (30 to 50 minutes). The discussion begins by looking for problems the students found in previous work and in a story about a student who missed his school bus. They are then asked if they find anything silly or confusing in the large drawings of absurd situations that were used in the movies. They are shown one at a time but not discussed. In the second part, two letters are distributed and discussed; the first is about missing lunch money (Letter 5) and the second is about the adequacy of garbage collection (Letter 3). (See Appendix C for copies of these letters and those that follow.) The discussion leader helps the students identify several potential problems. The children are asked to come to some definition of a problem and then tape recordings of two letters from "two other mayors" are played through earphones (Letters 6-7). The leader continues to help the students identify possible problems. The final letter is taken from previous work done while playing mayor. The point of the discussion is to help the students find problems themselves in the situations and letters presented.

6. Problem Formulation Discussion Plan (30 to 50 minutes). The discussion begins by reviewing the previous discussion on problem sensitivity. The students are then asked to generate questions for six of the absurd drawings they had been shown previously: the dog in a tree, the tree in a chimney, the teeter-totter with both ends up, the kite strings without kites, the ski tracks around a tree, and the stairs that do not go anywhere. Two letters (5 and 3) from the first discussion are again presented and the children are given help in making up questions about the problems that were raised. Two "replies" from mayors (see Appendix C, Letters 8-9) are then presented with regard to the taped letters from the first dicussion. Similarly, the children are helped to formulate questions that would clarify potential problems. The closing part is a discussion of formulations for a letter from I Am the Mayor previously worked by the children. The point of the discussion is to help the students ask questions themselves about potential problems in the situations and letters.

General Design

To create a teaching environment, an inquiry skills learning center was designed. The center was called "The Mayor's Conference" and it was set up to create the effect of a permanent learning center with four differentiated learning areas. A movie area allowed for the showing of the problem sensitivity and problem formulation movies. A discussion area allowed for the planned discussions of the pictures, tapes, or the letters. A reading area allowed for using the programed texts and The Productive Thinking Program (16 short problem solving booklets) written by Covington, Crutchfield and Davies (1966). A desk area allowed for reworking units of the Mayor's Work. The center was designed with the expectation that it would provide a sufficient amount of learning material to interest children for as many as four 50 minute periods. A learning center director was present at all times as were clerical aides; none functioned directly as teachers, unless the specific design of an experimental group called for teacher-directed teaching.

Except for some pilot experiments, all of the research was carried out in three public schools. All of the subjects for whom data are reported are from the three schools: one in southwestern Ohio and the other two in a single school district in a suburb west of Chicago. They are essentially schools for children from middle-class homes. The communities are not characterized by unusual wealth or predominant ethnic backgrounds; nor do they have particularly homogeneous populations. The school in Ohio is an elementary school; one of the schools in Illinois is an elementary school, the other a junior high school. It was requested that classes of children to be studied and classes from which samples were drawn be considered average by the school administrators. No particular effort was made to eliminate children of unusual talent from the studies; children obviously handicapped by an inability to read or by a gross inability to follow directions were rejected. For the three studies combined, the inquiry activity of 302 children is reported; for each time spent inquiring and three other scores measuring aspects of problem sensitivity, problem formulation, and search behavior were derived. The range of grades for the children is from third to seventh. Exact sample sizes and background characteristics, when relevant, will be specified for each study individually.

Technical problems immediately presented themselves when children were first instructed to be mayors. In the initial pilot testing, 12 fifth grade children were instructed simply and individually in about 10 minutes. About half of them were able to begin work. They seemed to perceive what it was they would do as mayor and were able to work for the entire experimental period (40 minutes to an hour) with only a small amount of assistance from the experimenter. The other children often seemed lost. They didn't know what it was they were supposed to do, and they couldn't ask the kind of questions that would help them to find out. At that time, it was thought that it would be necessary to give the instructions to each child individually. The next set of instructions were designed on the pattern of a branched programed text. The child was told a little bit about the task and then was asked to participate in a miniature inquiry situation, examples of which are shown in Figures 2 through 5. The instructions varied depending on the nature of the participation; the procedure took from 20 to 30 minutes. The instructions worked with almost every child; occasionally the experimenters found themselves working with a child who could not read or who could only read Spanish. But for practical purposes almost any child, as young as those in fourth grade, would start on an inquiry task which he would then continue relatively independent of adult help. From the standpoint of time and control, it seemed critical to convert the procedure so that it would be possible to give the instructions to an entire class at one time.

It seemed that what was lost in interaction with an individual child was gained in the freedom children feel to ask questions when they are part of their class. Subsequently, it was determined that third grade children could also be instructed to inquire in an open learning situation and that children as old as those in ninth grade are interested in the same materials.

For the first two studies, the instructions were given to groups of children, usually to an entire class at one time. A carrel was set up in the room and the instructions were given from a memorized script (see Appendix E). For the last study, the instructions were converted to a twenty minute film (see Appendix F) and was usually shown to all members of an experimental group at one time. Just before each child began, he was reminded briefly how to be a mayor. In the instructions, the children are asked to pretend they are mayors, and the general idea of a mayor's work is discussed with them. The different sections of the materials are explained, and they are shown how to use the carrel. Each child was assigned a secretary-experimenter, and it was emphasized that there are no right answers. They were told to do what they wanted to do because they were the mayor. Nothing was said to encourage them to continue working, no comment was made on how well they were doing, and no positive or negative consequences followed their decisions.

The data obtained are simply lists of page numbers and the associated time which has elapsed before another page is requested (see Figure 10). Each page is considered to be a unit, and the units are coded to indicate work received, questions viewed, information viewed, and the decisions made (see Figure 1). Although there are many possible scores and combinations of scores that can be derived with these data, attention has been focused on only a few of those possible. The scores used are actually operational definitions of the aspect of inquiry being studied. The score for problem sensitivity is equal to the number of question pages requested, i.e., the number of sets of questions (SQ). The score for problem formulation is equal to the number of questions used plus the number of times a question is implied by use of the main index, i.e., the number of questions asked (QA). The score for search behavior is equal to the number of file pages used, i.e., units of information (UI).

FIGURE 10

SAMPLE INQUIRY RECORD AND DERIVATION OF SCORES[a]

Unit[b]	Time[c]	Description of Unit	Scoring[d]
106	0-52	Memo on airport[e]	
261	0-18	Questions to 616, 620, 630	SQ
616	0-35	Officers of Clubs & Groups	QA, UI
620	0-11	Airport Planning File Index	QA, UI
623	0-50	Airport Plan	UI
630	0-08	Business Club File Index	QA, UI
631	0-24	Letter from Moss	UI
262	0-09	Questions to 338, 388, 584	SQ
338	1-10	Tinker History	QA, UI
388	0-48	Airport Information	QA, UI
584	0-53	City Council Record	QA, UI
300	0-08	Main Index	QA[f]
590	0-10	City Growth Charts Index	UI
596	1-03	Population	UI
263	0-24	Questions to 583, 608,623	SQ
608	0-25	Business Growth	QA, UI
806	0-13	Decisions to 960, 961, 962	
962	2-16	Do something right now	
962c	0-26	Glad to work, but can't meet	

Totals

SQ	3
QA	8
UI	11
Time[c]	10-57

[a] From the record of a fifth grade boy, see Subject A scores for unit 106 in Figure 13.

[b] cf. Figure 1 for explanation of coding.

[c] Minutes-seconds

[d] Scores:
SQ = Sets of questions requested
QA = Questions asked
UI = Units of information used

[e] cf. Appendix D

[f] It is assumed that the student has a question in mind when he uses the main index.

The Mayor's Work is coded by being numbered in the 100's. The Mayor's Questions are numbered in the 200's and The Mayor's Files are from 300 through the 700's. The data were entered into punch cards and a computer program was written to count the coded entries and add them into an individual's scores. SQ is equivalent to the number of 200's. QA is equivalent to a count of any pages 301 to 799 that corresponded to the multiple-choice formulation questions that the child had previously made available to himself plus the number of uses of 300 (the main index). In Figure 10, for example, after the child chose 261, information stored in the computer would indicate that questions leading to pages 616, 620, and 630 are now available to the child. When a subsequent choice (while working on the associated unit of work) was any one of these pages, a point was added into his problem formulation, QA, score. UI is equivalent to the uses of pages numbered 301 to 799.

The score for problem sensitivity reflects the number of problems sensed, not the magnitude of the incongruency. The student requests sets of questions (SQ) by indicating that there is a sentence in The Mayor's Work he wants to look into (see the numbers in the right hand margin of Figure 2). The score is at best a count of the number of problems the student thinks he senses in a letter, memorandum, or report. It should be noted that the score might only be an indication of the sentences about which he wants to ask or see questions. At worst, the score reflects a diffuse strategy for obtaining question pages. For these reasons the score is referred to as sets of questions requested. It is felt, though, that the more areas about which the student has demonstrated his interest the more problems he is looking into and that the score reflects the student's problem sensitivity. In sum, the operational definition of problem sensitivity for the research reported here is the number of sentences in a document of The Mayor's Work for which the student requests a set of questions (SQ).

The score for problem formulation is at best a count of the number of different ways in which a problem is developed. Each question asked (QA) by a student to find a unit of data is scored as an individual formulation. In addition, each time the student uses the main index, it is assumed that he has a question in mind (however unarticulated) and each use also adds in as an individual formulation. At worst, all of the question asking may be connected to a single main question in the student's mind. However, it is felt that any differentiation reflects continuing formulation, and that the amount of question asking is a reasonable gross indicator of the number of different dimensions along which a problem is viewed. There is also a difference, most likely, between choosing from a selection of multiple-choice questions and generating one's own. No doubt it is harder to inquire when no questions are suggested, but it is assumed here that the difference is qualitative and not quantitative. In sum, the operational definition of problem formulation is the number of questions asked (QA).

The score for search behavior presents no analogous difficulties; it is a count of all units of information (UI) used in The Mayor's Files before coming to a decision for any given piece of work. It includes indexes used and redundant uses of pages; it does not include pages requested but not viewed, nor pages accidently or randomly requested (by reversing numbers on the dial or by randomly generating page numbers). It is essentially a gross measure of the amount of data that a student made available to himself. The operational definition of search behavior is the number of file pages viewed, units of information (UI).

In addition, an inquiry time score was obtained for each individual by adding the time spent viewing all units including The Mayor's Work, Questions, Files and Decisions. Time spent interacting with the experimenter or in between viewing units was not counted in the measure of time.

Other scores were investigated during the course of the research but are not reported here for two reasons. First, some of the scores like independent search and dependent search (depending on whether the student used multiple-choice questions or his own questions to obtain data) added no substantially different information than that which is being reported. For clarity, such possibly intriguing scores were omitted from the present report. Secondly, time allowed only for an incomplete investigation of variables that were of secondary importance to this study such as scores related to the kinds of decisions the children made. With regard to decisions, it is important to point out that although these data have been carefully recorded, for possible future use, no attempt has been made to bring them into the purview of this report.

The methods of statistical analysis included chi-square tests and product-moment correlations which were used to investigate the relationship between variables. The effect of experimental independent variables was investigated by t-tests using paired comparisons for individual experimental groups and analysis of variance for differences between experimental groups. Other tests were used to solve specific problems of analysis. The level of statistical significance was set at the .10 level of probability for most analyses because of the exploratory nature of the research; it was most critical not to mistakenly miss any good leads. Exceptions are indicated and explained.

The questions that were investigated in the three studies are as follows:

Chapter 3. What does inquiry behavior in elementary school children look like? Are some children more prone to inquire than others? How do the inquiry scores relate to each other and to other variables?

Chapter 4. Do children as they get older tend, in terms of grade level, to have higher inquiry scores? What is the relationship of inquiry scores to differences in sex, reading level, and group measures of intelligence?

Chapter 5. What is the effect of differential teaching methods on inquiry scores? Can movies, programed teaching, or discussion be useful for increasing inquiry activity? Can a learning center environment designed to teach inquiry skills be useful for increasing inquiry activity? What is the differential effect of student and teacher direction of the learning center? What is the relationship of measures of creativity to inquiry scores?

Chapter 3

CHARACTERISTICS OF INQUIRY ACTIVITY

The first purpose of this study was to allow children to use the inquiry materials without limits on time and to describe the resulting behavior. Second, the purpose was to differentiate the children on the basis of the amount of time they spent inquiring and to look for differences in inquiry activity. Third, the relationship of inquiry measures to each other and independent factors was initially explored.

Shulman, in his study of teacher-trainees (1965, p. 266), "demonstrated that precise and meaningful descriptions of inquiry behavior can be made without the necessity of presenting subjects with specific 'problems' to solve. The early stages of the inquiry process, such as problem-sensing, can be observed and quantified readily, and the quantities so attained related meaningfully to other, more easily observed aspects of cognitive behavior." He obtained individual measures of problem sensitivity, information sources used, bits of material attended and time. It was found that time spent inquiring significantly correlated with problem sensitivity and with the number of information sources used, and similarly, problem sensitivity significantly correlated with information sources. He did not find that the number of bits of information his subjects used correlated with the other individual measures. The most striking finding was that subjects selected on the basis of independent measures of cognitive behavior had significantly different scores for problem sensitivity and time spent inquiring. Subjects who were theoretically expected to be more prone to inquire on the basis of his independent measures of cognitive behavior had significantly higher scores than subjects expected to have low interest in inquiry.

The present study explored the possibility that similar conclusions might be made with regard to the inquiry behavior of elementary school children. There is an initial close relationship between the two studies in that Shulman's measures of problem sensitivity, information sources, and bits of material attended correspond to the sensitivity, formulation, and search scores used here. But it should be noted that they are not identical primarily because of differences in measurement techniques. In contrast to his study, no attempt was made to preselect subjects on the basis of independent measures of cognitive behavior. In place of preselecting the children, they were differentiated on the basis of the total time they spent inquiring. Although the measures were not all intercorrelated in Shulman's study of teacher-trainees, it was hypothesized that they ought to be. A higher degree of correlation was particularly expected in the present study because the techniques of measurement are more interconnected and, for the scores reflecting formulation (QA) and search (UI) they are overlapping.

Ramdom samples were taken from average classes, i.e., they were not considered to be classes of "below average" or "gifted" children. Each child in the sample was provided with the opportunity to play Mayor one forty-minute session a day until he finished ten units of work. The total amount of time to complete the ten units was used as an independent variable against which to view the inquiry activity of the children. It was expected that variations in the amount of time on ten units would identify children with characteristically different scores for problem sensitivity (SQ), problem formulation (QA), and search behavior (UI).

Fifty-one children in fourth, fifth, and sixth grade, from each of the three participating schools, were included. Six classes were assigned by the schools and random samples of ten were drawn from each; however nine children were dropped from the original sample of 60 due to incomplete data because of absence, incorrect administration, or inability to learn the task. The sample size for each grade broken down into boys and girls is shown in Table 1. Although it was not possible to collect complete inquiry data on the original sample of 60 children, it can be seen that the subgroups for the 51 children to be reported on are approximately balanced for sex and grade level.

Instructions were administered using a demonstration carrel (see Chapter 2 and Appendix E). The work each child received included all of the ten documents in Appendix D. Each child received the documents one at a time in the same order (starting with 100 and ending with 109) as he requested them. The experimenter-secretary recorded each page the child requested in connection with each unit of work and the time spent viewing it. The children were permitted to work with the materials as long as they liked, and they all continued until they were told that there was no more for the Mayor to do.

Results

Some children finished in two 40 minute sessions; one took as many as six. The distribution is presented in Figure 11. The majority of the children took three or four sessions spread over three or four days respectively. However, the actual time spent inquiring was less than might be derived by multiplying the number of sessions by 40 minutes. During any session, time can be spent on the Mayor's Work, the Questions, the Files, the Decisions, dictating decisions, in other interactions with the experimenter that are outside of the requirements of the task, and in locating the documents for the child. Total inquiry time is the sum of the time viewing the documents; interaction and locating time are not included (see Chapter 2). The distribution of the total time spent inquiring is shown in Figure 12. The range included one child who spent as little as 14 minutes inquiring in two forty-minute sessions and at the other end of the continuum a child who spent 115 minutes in four sessions. Even though there is wide variation in the per cent of each session spent inquiring, there is a close relationship between the number of sessions and total inquiry time (see Table 2).

A check was made to find out if there was anything about the task that was particularly disliked. After each session, the secretary-experimenter would talk to the subject for a few minutes. The children were asked questions such as what they liked and disliked about playing Mayor. The discussions were summarized and recorded on the child's protocol; at a later time, all of the comments were evaluated for negative, neutral, and positive statements. Although the method of evaluation was subjective, it was clear that less than four per cent (2 children) on balance were negative and only 16 per cent (8 children) made both negative and positive comments or so few comments that a positive reaction was not apparent. Indeed, the children were often very intrigued and made comments such as "it's fun" and "really neat". One experimenter reported that a child interrupted her questions to say that "most of all he wanted us to know that he liked being Mayor."

TABLE 1

SAMPLE SIZE FOR THE STUDY OF THE CHARACTERISTICS OF INQUIRY ACTIVITY

	Grades			
	4	5	6	Total
Boys	7	7	10	24
Girls	10	9	8	27
Total	17	16	18	N = 51

TABLE 2

CONTINGENCY TABLE: NUMBER OF EXPERIMENTAL SESSIONS VS. TOTAL INQUIRY TIME

	Sessions[a]				
Time[b]	2	3	4	5	6
70-115	0	1	10	7	1
55-69	0	10	5	0	0
10-54	8	9	0	0	0

$X^2 = 46.87^{***}$

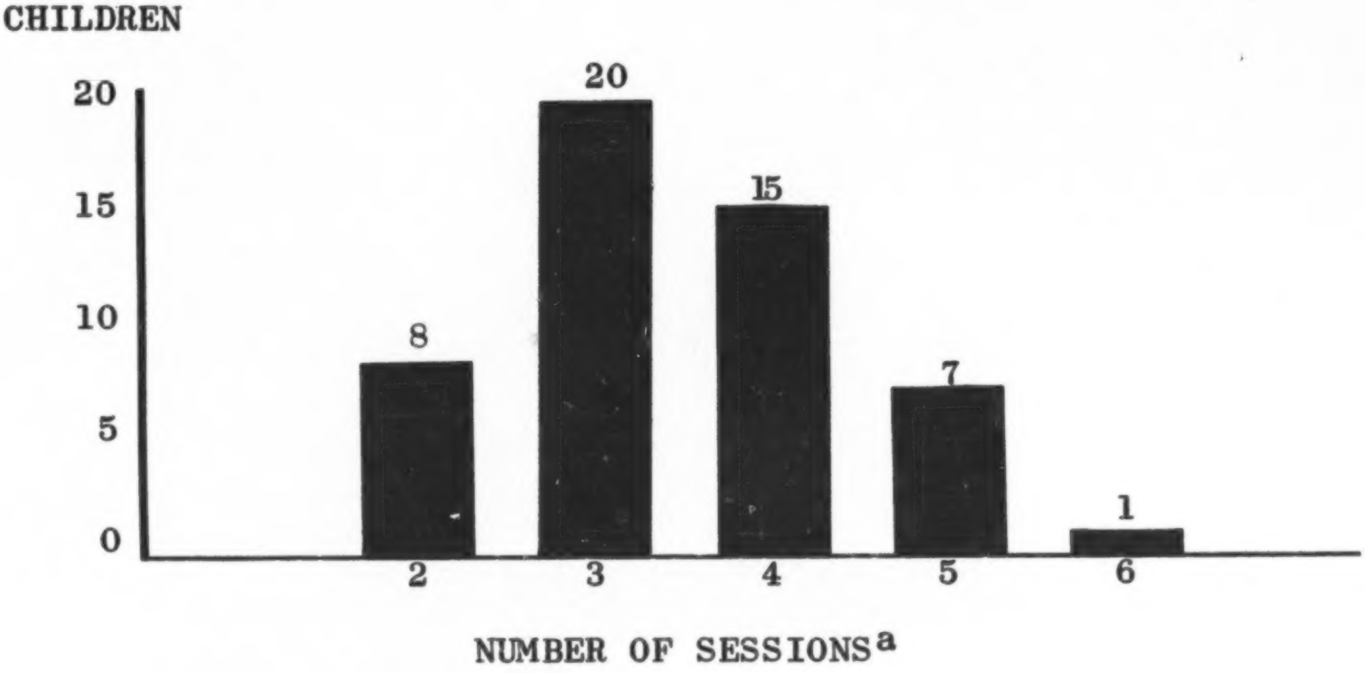
[a] The number of 40 minute periods offered once a day during which a child participated in order to finish ten units of work.

[b] Total inquiry time in minutes for ten units of work.

$^{***}p \leq .01$

FIGURE 11

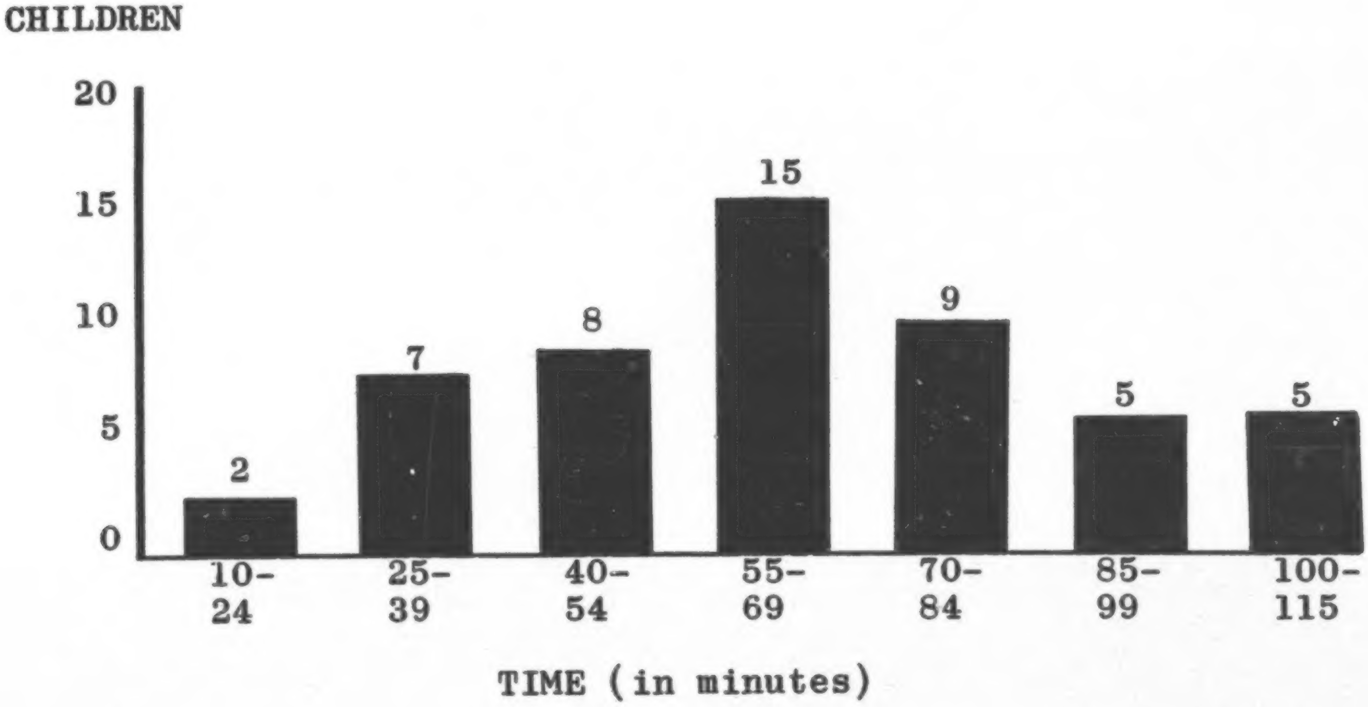
DISTRIBUTION OF NUMBER OF SESSIONS FOR EACH CHILD WHO PLAYED MAYOR



[a]The number of 40 minute periods offered once a day during which a child participated in order to finish ten units of work.

FIGURE 12

DISTRIBUTION OF TOTAL INQUIRY TIME FOR TEN UNITS OF WORK



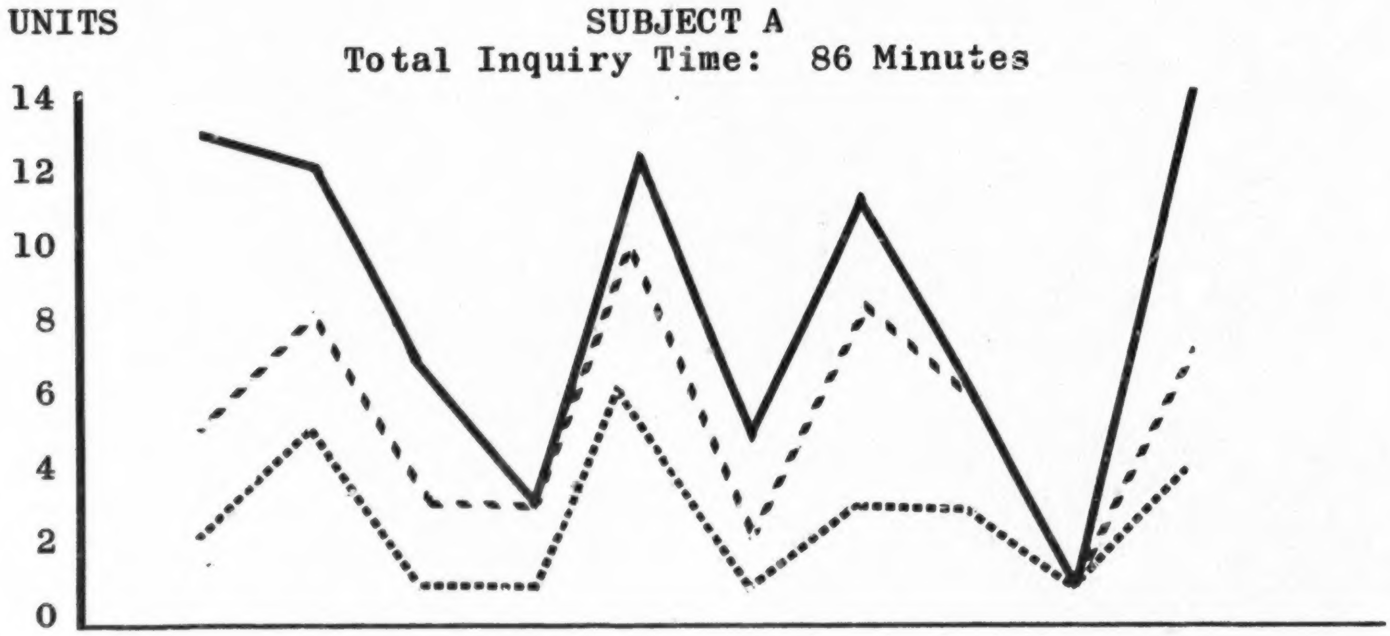
The description of the inquiry activity for individual children can be seen in a graph which plots the three inquiry scores serially for the ten units of work. Figure 13 shows two individuals who are very different kinds of mayors. Subject A was highly variable; he showed evidence of becoming aware of problems in many units of work and responded by asking questions and collecting data. Subject B was methodical and fairly unresponsive to the inquiry materials. He asked few questions and usually used little data before going on to another unit of work. The following results are derived from similar analyses using mean scores at each point and from mean inquiry scores over all ten units.

The problem of the reliability of the scores has two sides. With regard to data collection, reliability is nearly perfect. Two experimenters recording page numbers and associated times for the same subject rarely recorded conflicting page numbers or times different by more than a few seconds. With regard to the stability of the scores from one unit of work to the next, it is not clear how high the correlations ought to be. One might assume that a subject who measures high on one unit of work ought to measure relatively high on all other units of work, but one of the individual cases presented in Figure 13 (Subject A) demonstrates how variable the inquiry activity can be. (Notice that UI and QA on unit 108 are lower for Subject A than they are for Subject B.) The obtained correlations of scores on the last unit of work with all other units of work are shown in the top half of Table 3. As is readily apparent, the correlations with the last unit of work tended to get larger for all three scores as they became further removed in time from the first work. The general stability of the scores is even better documented when scores on two units of work are combined (see bottom half of Table 3). It would seem that there was an ongoing change occuring in the subjects as they continued to play Mayor--toward stabilization. The fact that the correlations with the paired units of work during the last half of the experiment ranged from .65 to .86 was taken as evidence for the reliability of the scores. It was concluded that it would be advisable in future studies to make repeated measurements on each individual. Except for the study reported in the next chapter where the need for a large number of subjects prohibited the possibility, repeated measurements were made in subsequent experiments by using a series of units of work.

The distributions of individual mean scores for ten units of work are shown in Figure 14. Since scores on

FIGURE 13

INQUIRY ACTIVITY OF TWO FIFTH-GRADE BOYS


SUBJECT A
Total Inquiry Time: 86 Minutes

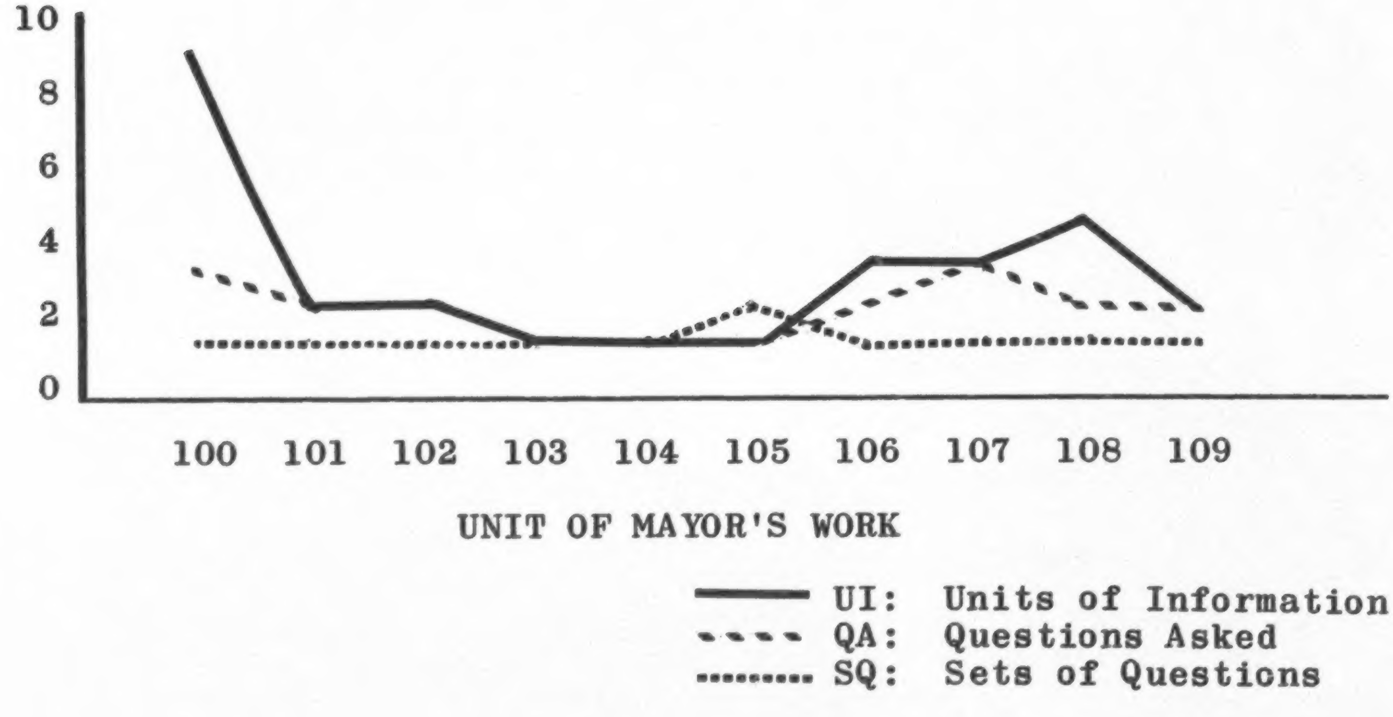

SUBJECT B
Total Inquiry Time: 57 Minutes

TABLE 3

CORRELATION OF SCORES ON UNITS OF WORK WITH SCORES OBTAINED LAST

Variable (Unit and Score)	Unit of Mayor's Work									
					Unit by Unit					
109	100	101	102	103	104	105	106	107	108	109
SQ	.13	.26	.08	.27	.54	.38	.74	.57	.41	—
QA	.18	.16	.22	.38	.66	.62	.69	.75	.50	—
UI	.17	.25	.27	.22	.59	.55	.62	.65	.41	—

Paired Units by Paired Units

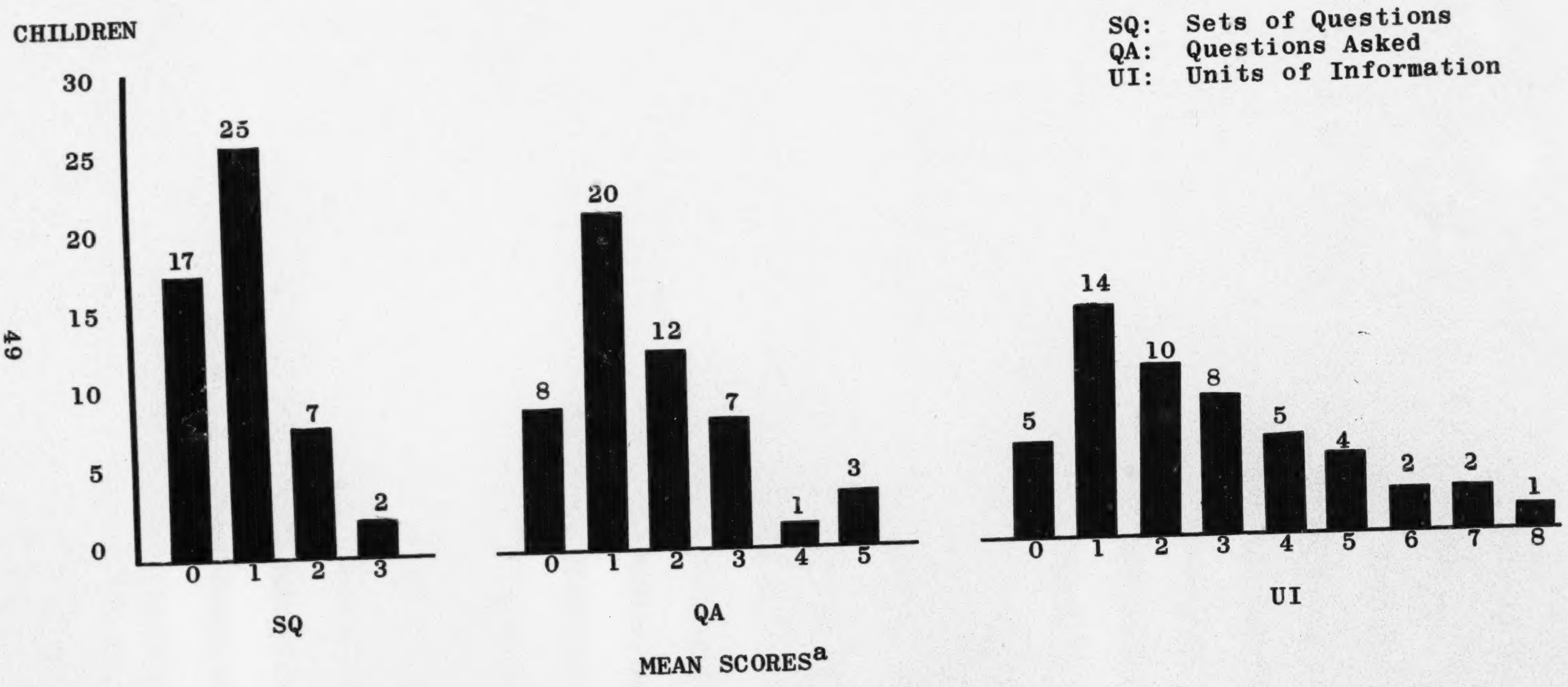
108 + 109	100 + 101	102 + 103	104 + 105	106 + 107	108 + 109
SQ	.25	.28	.65	.86	—
QA	.20	.40	.77	.82	—
UI	.21	.28	.68	.78	—

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information

2

FIGURE 14

DISTRIBUTIONS OF MEAN SCORES FOR TEN UNITS OF WORK



[a] Each bar includes all means that are included in the range 0.0 to 0.9, 1.0 to 1.9, 2.0 to 2.9, etc.

SQ, QA, and UI for every unit of work were sometimes zero, mean scores could be less than one. The incidence of scores less than one was highest for the number of sets of questions requested (SQ). This is consistent with the fact that the score has a limited range, whereas the number of questions the children ask (QA) and the number of units of information they use (UI) do not have limited ranges.[1] Distributions of the three scores tend to be normal, although all are slightly skewed toward the lower scores. The mode in each case is in the area of one. It is suggested that scores of zero and one represent less variable behavior; other data and further discussion are presented later in this chapter.

Mean scores, standard deviations, and intercorrelations of the scores are presented in Figure 4A. SQ is equal to about 1, QA to about 2, and UI to about 3. In general terms, children on the average are sensing a single problem, formulating a couple of questions, and searching into about three units of data. Together with the corresponding increase in the standard deviations, the results suggest that problem sensing generates problem formulating which in turn generates search behavior (also see Figure 14). As hypothesized, the correlations are high and point to the relationship of the scores to each other. With regard to the correlation of QA and UI (.94), it would seem, though, that the scores are substantially the same in spite of their different means and standard deviations.

The children were divided into three approximately equal-sized groups on the basis of their total time spent inquiring. As can be seen in Figure 12, the natural groupings include children who spent up to 54 minutes, 55 to 69 minutes, and 70 minutes or more. The rationale for the division rests mainly on the fact that the time score is theoretically an independent measure; certainly

---

[1] The possible range for sets of questions is from 0 to 9 because that is the maximum number made available on any unit of The Mayor's Work (see Appendix D). The number of questions available for any unit of work are 15 or more and this does not include questions the children can generate themselves. The units of information available at all times is approximately 250 documents; possible redundant uses of documents removes even this limit on the range.

TABLE 4A

GRAND MEANS PER UNIT OF WORK AND INTERCORRELATIONS AMONG INQUIRY SCORES (N = 51)

			Correlations		
Score	Mean	S.D.	SQ	QA	UI
SQ	1.3	.71	—		
QA	2.1	1.30	.86	—	
UI	3.1	1.97	.77	.94	—
Time	6.4	2.37	.61	.56	.55

TABLE 4B

GRAND MEANS PER UNIT OF WORK AND INTERCORRELATIONS FOR THREE GROUPS DIFFERENTIATED ON INQUIRY TIME

			Correlations		
Score	Mean	S.D.	SQ	QA	UI
High Inquiry Time (n = 19)					
SQ	1.8	.73	—		
QA	3.0	1.37	.76	—	
UI	4.4	2.08	.62	.89	—
Time	8.9	1.25	.18	.08	.06
Middle Inquiry Time (n = 15)					
SQ	1.3	.57	—		
QA	1.9	.97	.83	—	
UI	2.7	1.42	.70	.83	—
Time	6.1	.35	.06	.08	.06
Low Inquiry Time (n = 17)					
SQ	.8	.46	—		
QA	1.3	.90	.76	—	
UI	2.0	1.44	.74	.92	—
Time	3.8	1.10	.69	.62	.60

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

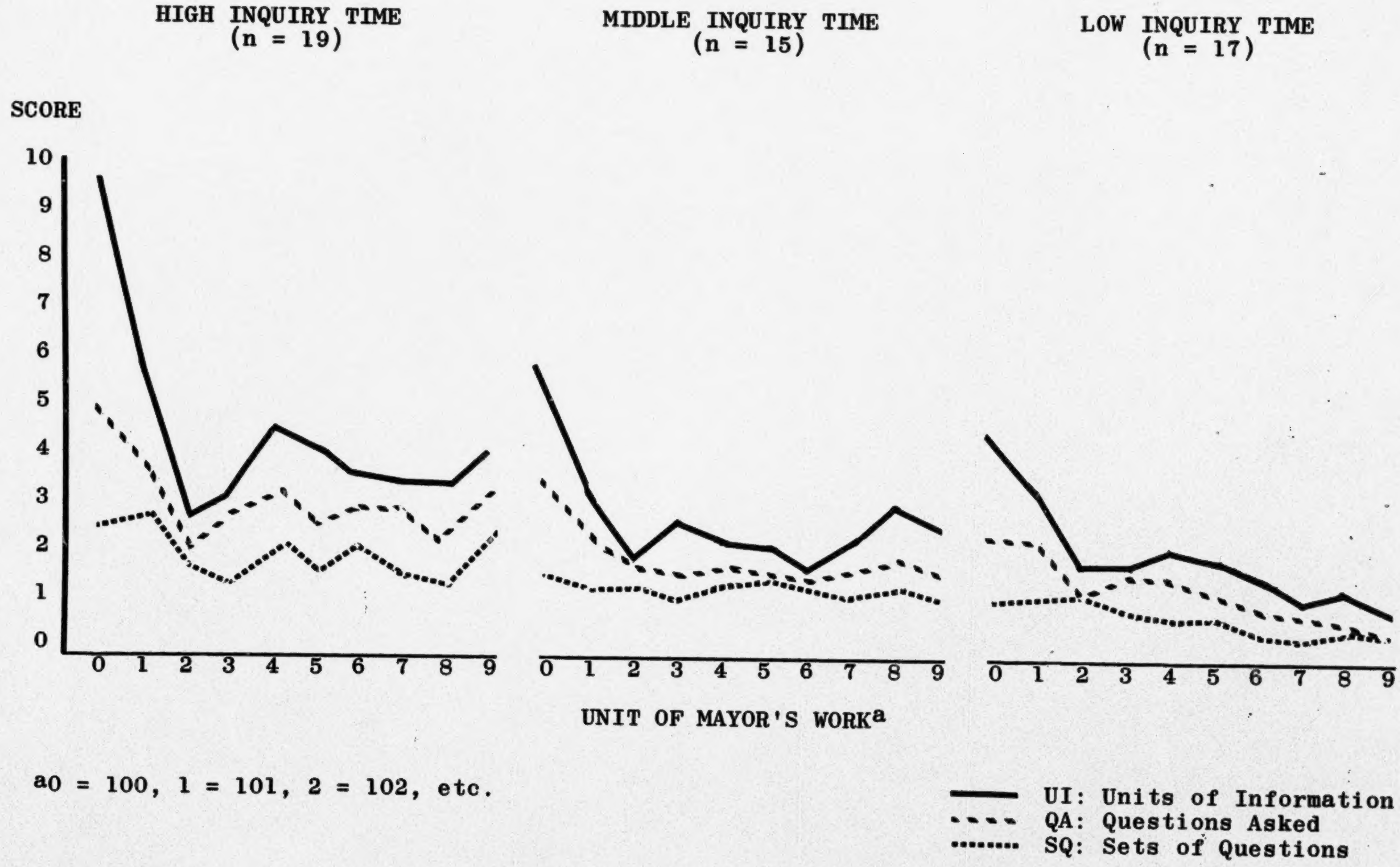
it was the most independent measure available and yet relevant. The most obvious criticism that can be leveled is that the more the children engage in inquiry activity, particularly given the techniques of measurement used here, the more time they spend. The correlations between time and the other scores in Figure 4A sufficiently attest to this relationship. This is not the whole story, though, as the following analyses show using the three groups, i.e., Low Inquiry Time (n = 17), Middle Inquiry Time (n = 15), and High Inquiry Time (n = 19).

The means, standard deviations, and intercorrelations of the scores for the three groups are presented in Figure 4B. The correlations are substantially the same, but several differences should be noted. Once the groups are divided on the basis of time, no relationship remains for the High and Middle groups between the inquiry scores and time. In contrast, the criticism that could have been leveled against using inquiry time as the basis for differentiating the groups is valid for the Low Inquiry Time group. Although the relationship is not perfect, there is a general tendency for the more these children engage in inquiry activity, the more time they spend. But for the other two groups, something else is happening. Before exploring this avenue, it should be noted that the other correlations are all lower than they are for the group as a whole. There seems to be sufficient independence to warrant future investigation where differential effects could be attempted. The scores for each group for each unit of work are shown relative to each other in Figure 15. The general tendency for questions to generate the use of information is apparent.

The expectation was that groups differentiated on time should be characteristically different on other measures of inquiry activity. It can be seen in Table 4b that all of the means are in their predicted relationship to each other. In one test of this hypothesis, an analysis of variance was used to test for significant differences between the groups on SQ, QA, and UI (see Table 5). The results show clearly that there are significant differences between the highest and lowest means for all three scores. In a second test, the variability of each individual was averaged for each group (see Table 6). Comparing the variability of individuals, it can be seen that it is significantly different for the children in the High Inquiry Time group for all three scores. Differences between the groups can be seen graphically in Figures 15 and 16.

FIGURE 15

INQUIRY ACTIVITY FOR THREE GROUPS DIFFERENTIATED ON INQUIRY TIME



a0 = 100, 1 = 101, 2 = 102, etc.

TABLE 5

ANALYSIS OF VARIANCE OF DIFFERENCES BETWEEN THREE GROUPS DIFFERENTIATED ON INQUIRY TIME

Score	df	MS	F
SQ:			
Groups	2	4.07	11.24***
Error	48	.36	
QA:			
Groups	2	12.11	9.64***
Error	48	1.26	
UI:			
Groups	2	27.56	9.52***
Error	48	2.89	

***$p \leq .01$

TABLE 6

MEAN VARIANCE AND F-RATIOS FOR THREE GROUPS DIFFERENTIATED ON INQUIRY TIME[a]

	Mean Variance[b]			F-Ratio		
Score	H	M	L	H/L	H/M	M/L
SQ	1.76	.46	.46	3.83***	3.83***	1.00
QA	4.70	1.99	1.75	2.68**	2.36*	1.14
UI	14.89	6.53	4.92	3.03**	2.28*	1.33

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information

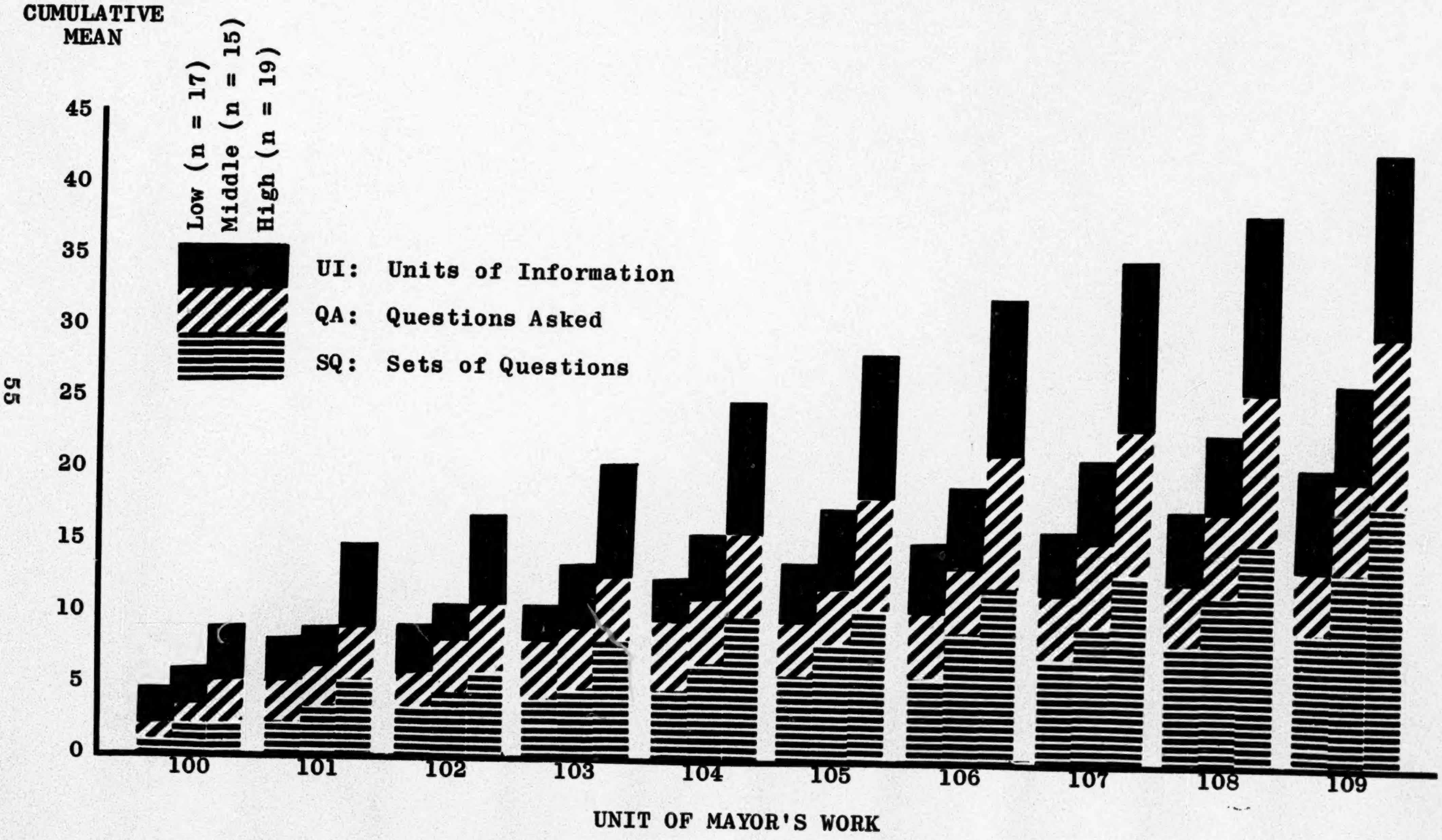
[a] H: High Inquiry Time (n = 19)
M: Middle Inquiry Time (n = 15)
L: Low Inquiry Time (n = 17)

[b] Sum of the variance for every individual for ten units of work divided by n.

*$p \leq .10$
**$p \leq .05$
***$p \leq .01$

FIGURE 16

CUMULATIVE MEAN SCORES FOR THREE GROUPS DIFFERENTIATED ON INQUIRY TIME



Note: The top of each coded bar represents the cumulative mean for the respective score.

A critical difference can be seen in Figure 15 by placing a ruler under all the points of any of the scores for the high group and noticing how after unit 101 that all of the points for the low group are beneath those of the high group. Notice in Figure 16, when viewed from left to right, how the scores progressively differentiate. Table 7 shows that grade and sex are not related to the inquiry groups.

Viewing the data from the perspective of Figure 16 suggests that another difference has to do with the ratio of information used to problems sensed. The left side of Table 8 shows this relationship. There is a greater proportion of the higher ratios of UI to SQ in the High Inquiry Time group and the chi-square value is significant. This result suggests that the group not only processes more information, but that it uses more information for each sensed problem. Differences in processing rate are shown on the right side of Table 8. The distribution of search per minute, UI/UI time, is relatively high for the High group in the slowest processing level, it shifts over one for the Middle group, and is highest for the Low group in the fastest processing level. The chi-square value is significant, and the meaning is that the children at higher levels of inquiry activity processed information slower.

An important view of the groups would be to look at the scores obtained while holding the factor of time constant. This was not precisely possible to achieve in the present study; however, total inquiry scores were obtained over units engaged in by each child for one session they all had in common--the second session (see Table 9). Although the relationship of SQ to the inquiry groups was not significant, it was for QA and UI. The High Inquiry Time group tended to ask more questions and tended to use more information in terms of the trichotomous distributions and chi-square values than the other groups. But the lower right contingency table shows the relationship of UI time and the inquiry groups; the High group also spent more time searching for information. This explains the UI scores, but it raises a question about how in an analysis where the scores have been ostensibly equated for time, the search time is not equal for the groups. It seemed that some of the associated time of the other scores should be correspondingly lowered for the High group and the Middle group. Table 10 shows, though, that the distribution of second session inquiry time is significantly different than would occur by chance, i.e., the higher total time groups spent

TABLE 7

CONTINGENCY TABLES: GRADE LEVEL AND SEX VS. INQUIRY TIME

Time	Grade				
	4th	5th	6th	Boys	Girls
H	5	6	8	10	9
M	4	6	5	6	9
L	8	4	5	8	9

$X^2 = 2.52$ $X^2 = .58$

TABLE 10

CONTINGENCY TABLE: INQUIRY TIME FOR ONE EXPERIMENTAL SESSION VS. INQUIRY TIME

Time[a]	Second Session Time[b]		
	≤ 9.9	10.0-19.9	≥ 20.0
H	0	8	11
M	0	7	8
L	2	12	3

$X^2 = 9.09$*

[a] Range = 2-6 sessions

[b] Range = 6-29 minutes

*p ≤ .10

H: High Inquiry Time (n = 19)
M: Middle Inquiry Time (n = 15)
L: Low Inquiry Time (n = 17)

TABLE 8

CONTINGENCY TABLES: UI/SQ AND UI/UI TIME VS. INQUIRY TIME

	UI/SQ			UI/UI Time		
Time	≤ 1.9	2.0-2.9	≥ 3.0	≤ .9	1.0-1.9	≥ 2.0
H	43	58	64	68	75	22
M	58	41	34	32	69	32
L	38	36	35	11	45	53
	X^2 = 11.09**			X^2 = 56.91***		

SQ: Sets of Questions
UI: Units of Information
UI/UI TIME: Units of Information per minute

H: High Inquiry Time (Scores = 165)
M: Middle Inquiry Time (Scores = 133)
L: Low Inquiry Time (Scores = 109)

Note: If there were ratios for each child for each unit (U) for each group (H,M,L), the totals for the contingency tables would be 10 U x 19 H = 190, 10 U x 15 M = 150, and 10 U x 17 L = 170. But for H, UI = 0 in 25 cases, for M, UI = 0 in 17 cases, and for L, UI = 0 in 61 cases. Therefore the actual totals are H = 190-25 = 165, M = 150-17 = 133, and L = 170-61 = 109.

**p ≤ .05
***p ≤ .01

TABLE 9

CONTINGENCY TABLES: TOTAL INQUIRY SCORES FOR ONE EXPERIMENTAL SESSION (THE SECOND) VS. INQUIRY TIME

	SQ			QA		
Time	0-2	3-5	≥ 6	0-2	3-8	≥ 9
H	4	10	5	2	9	8
M	1	11	3	0	12	3
L	6	9	2	6	7	4
		X^2 = 4.69			X^2 = 10.95**	

	UI			UI Time		
Time	0-5	6-11	≥ 12	0.0-3.9	4.0-7.9	≥ 8.0
H	4	8	7	0	6	13
M	3	10	2	1	10	4
L	9	4	4	7	7	3
		X^2 = 9.11*			X^2 = 19.92***	

H: High Inquiry Time (n = 19)
M: Middle Inquiry Time (n = 15)
L: Low Inquiry Time (n = 17)

SQ: Sets of Questions (range = 0-8)
QA: Questions Asked (range = 0-15)
UI: Units of Information (range = 0-24)
UI Time: Minutes viewing information (range = 0-17)

*$p \leq .10$
**$p \leq .05$
***$p \leq .01$

correspondingly more time inquiring within the experimental session. The difference must be accounted for by more time spent by the lower total time children in such activities as dictating decisions and in interaction with the experimenter. In the final analysis, time and inquiry activity are very closely related. The higher inquiry time groups not only spent more time overall, but during a given period of experimental time spent more of it actively engaged in inquiry activity.

Discussion

The study provides beginning answers to the question, what does the inquiry behavior of the elementary school child look like? When fourth, fifth, and sixth grade children are provided with the opportunity to inquire, they demonstrate that they can and are willing to look into problems, ask questions, and use data before coming to decisions. The children were not encouraged to continue their work, no comments were made on how they were doing, and no consequences followed their work. Fifty-one children spent no less than two sessions, the majority spent three and four. If we were to assume that all of the reasons for excluding the data for nine children out of the original sample of 60 were invalid, we could say that only 15 per cent of the children were either unable or unwilling to sustain an independent inquiry. Using this conservative estimate, it is possible to conclude that 85 per cent of the elementary school children sampled can sustain an inquiry without external pressures, and with few exceptions, they say they enjoy the activity. There is wide variation, though, in the level of inquiry sustained.

There is a distinct difference between levels of inquiry when groups are differentiated on the basis of time. This finding corroborates Shulman's results (1963 and 1965) for teacher-trainees. Consistent with Shulman's findings, children high on total inquiry time were characteristically higher on the measures of problem sensitivity (SQ) and problem formulation (QA). In the present research, the same children were also characteristically higher on measures of search behavior (UI). This difference may be due to the way in which inquirers are operationally defined in the two studies. Shulman preconstructed extreme groups on the basis of selection tests; here the groupings depended on the amount of time the children actually inquired. Since Shulman found that time correlated significantly with problem sensitivity and information sources used (his indicator of formulation), it would be expected that time is a general correlate of inquiry activity. The central finding is in connection with the hypothesis made in the introduction to this study, i.e., children grouped on the basis of time spent inquiring have characteristically different scores on other measures of inquiry activity.

The finding that inquirers exhibit variability is consistent with the generally acceptable idea that successful problem solving and good inquiry require openness and the possibility for a variety of behaviors in any situation. On the level of individual analysis, the variation was seen in Figure 13 for subject A. His inquiry activity might be described as following his own interests. The parallel high points in the curve represent in depth study of problems; the low points represent apparent disinterest. The curves for subject B, who was in the middle inquiry group, show little similar variation. On the level of group analysis, the scores over ten units of work show analogous variability for the children who worked longest, and the amount of variation is significantly greater for the children in the high inquiry group.

The groups were also differentiated on several other factors. Considering the high inquiry group versus the low inquiry group, there is a tendency for the ratio of information-used to problems-sensed to be greater for the high group. It was not the case, though, that the high group simply spent proportionately more time to process the increased amount of information. Consistent with an expectation that follows from the findings of Kagan (1966) on reflective and impulsive reactions or Shulman on processing rate, the high inquiry group had the highest proportion of slowest processing rates. The differences between the groups generally hold when the scores are equated for overall experimental time. But of more interest is the fact that the high inquirers spent more time actively engaged in inquiry activity during the same experimental period.

How do the inquiry scores relate to each other? For the present study, they are highly intercorrelated; in the case of QA to UI, a question of independence was raised. The results are partially consistent with those of Shulman but simpler in that all scores are highly correlated. Since the processes are interdependent, it was theoretically expected that they would be correlated. Therefore, the problem of independence should be formulated as a series of related questions: (1)

how much independence is reflected in the present correlations, (2) how much of the dependence is due to the technique of measurement, and (3) how much of the dependence is due to the interrelatedness of the mental processes involved? The answer to (1) for the subsequent studies reported here is that the measures of problem sensitivity (SQ) and search behavior (UI) can be viewed as having a degree of independence which makes them important to investigate separately. For the moment, the score for problem formulation (QA) does not seem to add to a description of inquiry behavior. The question will be raised again in the following study. The answers to questions (2) and (3) were to be pursued directly in subsequent experiments by investigating the differential effects of teaching on the inquiry scores, but the lack of differential effects (see Chapter 5) requires that the questions be left as a subject for future research. How do inquiry scores relate to other variables? In the present study, there are no sex or grade level differences for measures of problem sensitivity, problem formulation, or search behavior--considering 51 children over fourth, fifth, and sixth grade. This question will be considered in more detail in Chapter 4.

Similar to Shulman's conclusions, this research has demonstrated that it is possible to obtain and describe the inquiry behavior of elementary school children without presenting them with specific problems to solve. Scores for problem sensitivity (SQ), problem formulation (QA), and search behavior (UI) were obtained and the task was regarded favorably by most of the children. Without encouragement or pressure, the children inquired in forty-minute sessions from two to six days, and it should be noted that they were randomly selected from regular school classrooms. When viewed over a series of units of work, the scores tended to be stable. The main findings follow: The fourth, fifth, and sixth grade elementary school children studied were all able to sustain an independent inquiry as Mayor of a simulated, small city for ten units of work--until they were told that there was no more for the Mayor to do. The differences among individuals in their inquiry activity varied greatly and could meaningfully be grouped in terms of total time spent inquiring. Grouped on this basis the groups had characteristically different scores on measures of problem sensitivity, problem formulation, and search behavior. The scores of the children in the low inquiry group were significantly less variable than the scores of the children in the high inquiry group. In addition, the children in the high inquiry group tended to process more information per problem sensed, to process information more slowly, and to spend more time per experimental period actively engaged in inquiry activity.

Chapter 4

DEVELOPMENTAL TRENDS

The central question of this study was whether inquiry scores increase as a function of grade level in school. It was convenient at the same time to explore the relationship of inquiry scores to several other variables. In addition, the problem of the independence of the inquiry scores was investigated again from the viewpoint of a single unit of work.

With regard to the young child there can be no question that intellectual and physical abilities improve as a function of age. The quality of mental abilities, whether or not in distinct stages, changes as a child gets older. The obvious question is whether inquiry behavior would also tend to change. The general theory (Allender, 1967b) that forms the basis for the development of the inquiry materials and corresponding scores was meant to include all forms of inquiry behavior--elementary sensorimotor learning, verbal learning and more complicated cognitive processes. As a theory, it does not account for developmental differences except to point out that some learning is determined by genetic history and some is not. If indeed the skills involved are general, one would expect no particular developmental differences in inquiry scores. For instance, a child's interest in exploring his environment might be as high or higher than his interest as an adult. Alternatively, the occurrence of striking changes in mental abilities as children grow older argued for the possibility that inquiry skills might improve as a function of age. The investigation was exploratory and no hypotheses were formed. We have already seen in Chapter 3 that over three grade levels--fourth through sixth--there were no corresponding increases in inquiry scores. In the present study, the sample of grade levels was expanded as well as the size of the samples for each grade level.

Scores on a school-administered group test of intelligence and a measure of reading level (to investigate its possible overriding influence) were investigated for their relationship to inquiry scores. The investigation of the effect of intelligence and reading level was also exploratory. Given the fact that inquiry measures are meant mainly to reflect divergent thinking processes, it would not be expected that they would be highly related to measures of what are basically convergent thinking processes. Yet, Shulman (1965) found significant relationships between inquiry measures and a mathematics achievement test. In the first study, no evidence was found for a relationship of the inquiry scores to sex differences. Here, an extended study of sex differences was undertaken over a wider distribution of grades together with the investigation of intelligence and reading scores. No hypotheses were made with regard to differences in intelligence, reading, or sex.

In the study reported in Chapter 3, the measure of formulation (QA) was almost perfectly correlated with search behavior (UI) and slightly less correlated with problem sensitivity (SQ). The correlations were for mean measures over ten units of work. In the present study, the relationship of the measures to each other was explored for a single unit of The Mayor's Work. Since in later experiments, changes effected by teaching would be expected to be reflected in changes between work on individual units, a greater independence of scores for single units would argue for the continued utility of each score.

The sample included 228 children from five grade levels: third through seventh.[1] The sample size for each grade broken down into boys and girls is shown in Table 11. The sample sizes for the five grades were not balanced because of scheduling difficulties. The sample sizes for boys and girls were approximately balanced; the particular number of each sex depended upon the number of boys and girls assigned to the classes participating. It was only possible to collect comparable scores on group intelligence and reading for a minority of the children; the breakdown of the subsample is presented in Table 12. The lack of complete data seemed to be the irrelevant consequence of the decision of administrators to use various tests of intelligence and reading. An additional problem was created by the date when the tests were administered. For these reasons, there were no data for the sixth and seventh grade children and, in the final analysis, why the subsample was relatively small.

---

[1] The sample included the data for the 51 children in the first study from their first sessions plus 177 additional children on whom data were collected for only one experimental session.

TABLE 11

SAMPLE SIZE FOR THE STUDY OF DEVELOPMENTAL TRENDS

	Grades					
	3	4	5	6	7	Total
Boys	30	34	16	21	16	117
Girls	30	33	15	14	19	111
Total	60	67	31	35	35	N = 228[a]

[a] Includes the 51 children reported on in Chapter 3.

TABLE 12

SUBSAMPLE SIZE FOR THE STUDY OF DEVELOPMENTAL TRENDS

	Grades			
	3	4	5	Total
Boys	13	22	12	47
Girls	12	22	14	48
Total	25	44	26	N = 95[a]

[a] Only those children with comparable tests of reading level and intelligence were included.

Only the scores for the first unit of work were used because it was the one unit in common worked by all of the children. In this study, the data for all of the children in each class assigned to work with us were included except where scheduling difficulties interfered or where a child was judged as not understanding the instructions (less than 8 per cent). The classes were assigned from normal school programs. The children in the sample are from all three of the participating schools. Scores for problem sensitivity (SQ), problem formulation (QA), search behavior (UI), and time were obtained for each child. Where available, total scores from the Lorge-Thorndike Intelligence Test and the reading scores from the Iowa Tests of Basic Skills were taken from the children's school records. These data along with the information of each child's sex and grade level were the basis of the analyses of the study. Analysis of variance, chi-square tests, and correlation were used to analyze the data.

The instructions and manner of their presentation were the same as reported in Chapter 3. Scores were obtained for the children's work on Unit 100 (see Appendix D). Many of the children worked other units after 100 and some did not, depending on how much time they spent on the first unit. Each child was permitted to work for forty minutes. In order to have a common point of comparison for all the children, only the first unit was used as the basis of the scores. The manner of data collection was the same as previously reported. The experimenters, carrels, and methods of data processing were also the same as were the operational definitions of the scores.

It was expected that all scores would either increase with grade level or all not increase, i.e., no differential effects were expected for SQ, QA, UI, or time spent inquiring. Sex differences and grade level differences were analyzed in a single analysis of variance, one for each score, and parallel effects were anticipated. Given the close correspondence of the inquiry scores, it was considered adequate to look at the relationship of only search behavior scores and time to reading and the intelligence measure. Time and UI were used because their significance is less contingent upon any particular theoretical formulation. UI scores also have the advantage of being generally higher than the other inquiry scores and therefore less affected by the error introduced by any strategy which includes dialing for many pages. With regard to the interrelationship of the inquiry scores, it was expected that they would be highly correlated but not as high as they were when they were based on ten units of work.

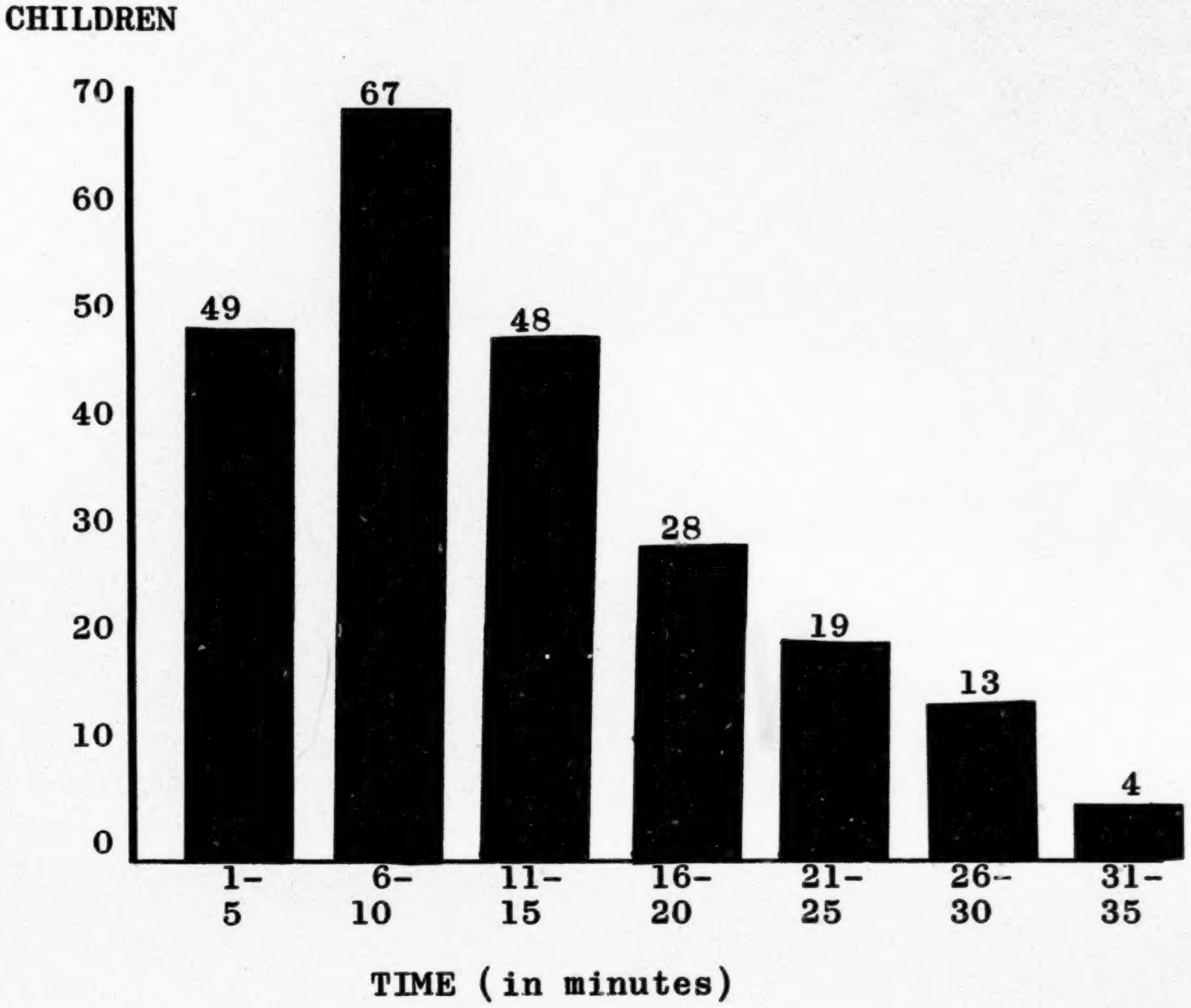
Results

The distributions for time, SQ, QA, and UI are shown in Figures 17 and 18. These distributions are for scores obtained by the children for one unit of work and they are the distributions of the actual raw scores. Their shape is similar to that of the distributions of mean scores for ten units of work shown in Chapter 3, but as would be expected they are more spread out. The figures show that the individual scores, like the mean scores, for SQ and QA tended to have normal distributions, but note again that they were skewed toward lower scores. The distribution of time scores was similar. The UI scores clearly did not tend toward a normal distribution if scores of zero are included. A modal group of 29 used no data at all; this is shown in Figure 18 as a column separated from the remainder of the UI scores. When the nonzero scores are considered in intervals of 2 units, the distribution was like the others. There were many children who used relatively little data before coming to a decision on unit 100, but of unique interest is that more than ten per cent used no data at all. In general, the scores appeared to be the product of the combination of two kinds of inquiry behavior as they were over ten units of work. The higher scores tended to be more variable and formed one side of a normal distribution. The lower scores were less variable.

Mean inquiry scores by sex and grade level and the results of the analysis of variance used to investigate sex and grade level differences are presented in Tables 13 and 14. The scores for the boys and the girls were similar and the analysis revealed no significant differences. Grade-level differences were significant for all four scores. With the exception of third grade in each case, the means for each score for boys and girls combined increased in order of grade level. In contrast, the third grade means were higher than the fifth grade means for SQ, QA, and UI, and higher than the seventh grade mean for time spent inquiring. An analysis of the third grade means and the degree to which they are out of sequence is shown in Table 15. They are equivalent to fifth-grade means for SQ and UI. The mean for QA is significantly higher than the fifth-grade mean, and mean time is equivalent to the seventh-grade mean. These conflicting results will be discussed.

FIGURE 17

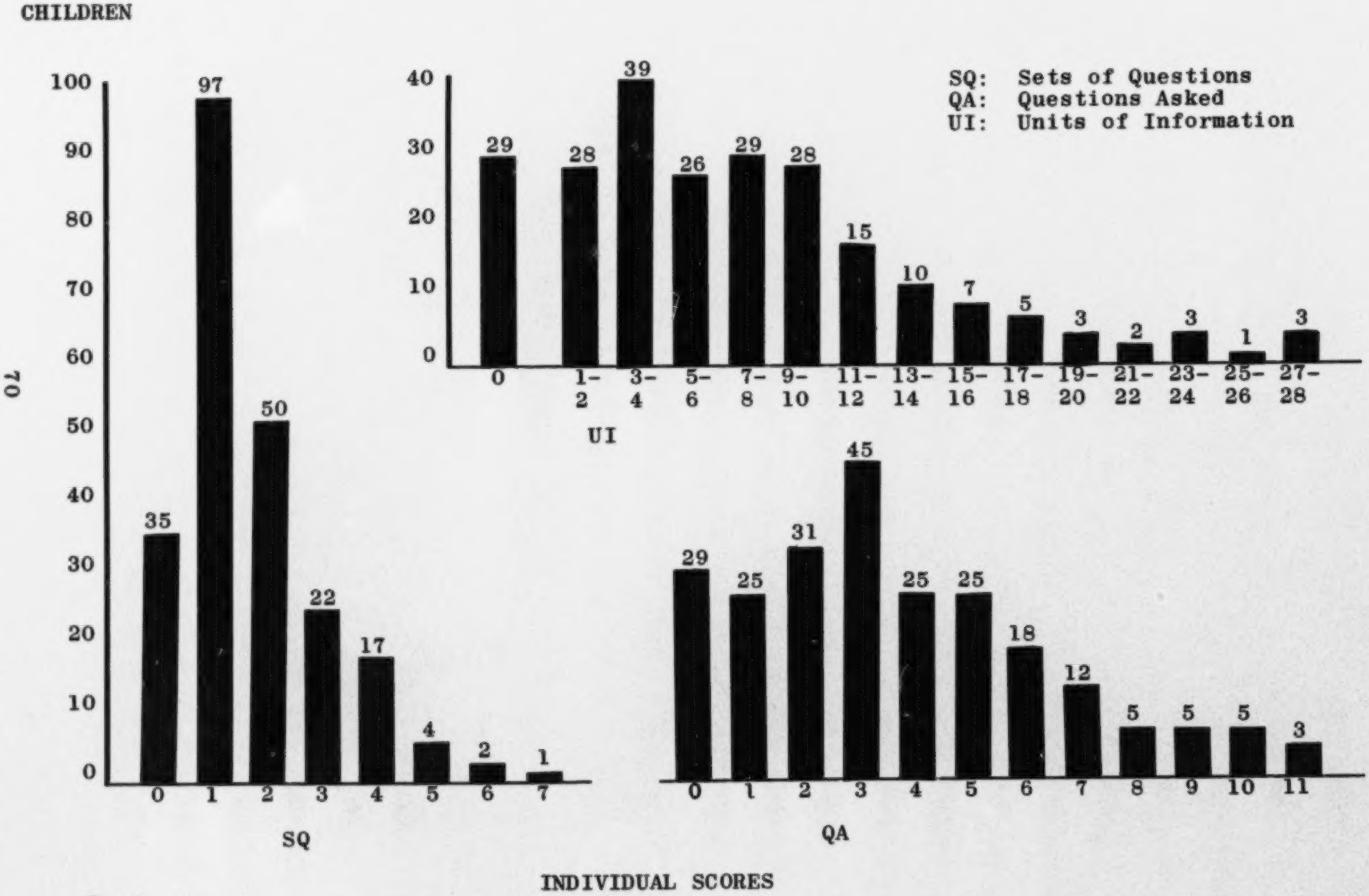
DISTRIBUTION OF INQUIRY TIME FOR ONE UNIT OF WORK[a]



[a] Unit 100

FIGURE 18

DISTRIBUTIONS OF SCORES FOR ONE UNIT OF WORK[a]



[a] Unit 100

TABLE 13

MEAN INQUIRY SCORES BY SEX AND GRADE LEVEL FOR ONE UNIT OF WORK[a]

Variable	Boys		Girls		Boys and Girls	
Grade and Score	Mean	S.D.	Mean	S.D.	Mean	S.D.
Third						
SQ	1.6	1.63	1.4	1.19	1.5	1.42
QA	4.4	3.41	3.4	2.76	3.9	3.12
UI	8.4	7.36	6.8	5.90	7.6	6.66
Time	13.8	8.43	14.6	8.86	14.2	8.59
Fourth						
SQ	1.4	1.30	1.5	1.15	1.4	1.22
QA	2.6	2.06	2.8	2.12	2.7	2.08
UI	4.5	4.13	5.4	4.90	4.9	4.51
Time	9.7	7.30	11.6	7.63	10.6	7.47
Fifth						
SQ	1.4	1.15	1.4	1.35	1.4	1.23
QA	3.1	2.16	2.9	2.63	3.0	2.36
UI	7.2	7.11	4.9	4.17	6.1	5.90
Time	11.4	7.22	9.8	7.10	10.6	7.09
Sixth						
SQ	1.7	1.24	2.1	1.41	1.9	1.31
QA	3.8	2.41	5.1	3.27	4.3	2.81
UI	7.0	5.23	10.6	8.01	8.5	6.63
Time	10.9	6.79	16.2	8.00	13.0	7.66
Seventh						
SQ	2.0	1.15	2.3	1.25	2.2	1.20
QA	4.3	2.12	4.2	2.17	4.2	2.12
UI	9.2	5.05	8.9	5.44	9.1	5.19
Time	13.7	3.82	14.2	7.42	14.0	5.97
All Grades						
SQ	1.6	1.34	1.7	1.27	1.6	1.31
QA	3.6	2.62	3.5	2.61	3.5	2.61
UI	7.0	6.00	7.0	5.88	7.0	5.93
Time	11.8	7.25	13.2	8.06	12.4	7.67

[a] Unit 100

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

TABLE 14

ANALYSIS OF VARIANCE OF DIFFERENCES BETWEEN SEX AND GRADE LEVEL GROUPS

Score	df	MS	F
SQ:			
Sex	1	.56	.34
Grade	4	4.37	2.60**
S x G	4	.93	.55
Error	218	1.68	
QA:			
Sex	1	.16	.02
Grade	4	25.31	3.90***
S x G	4	7.36	1.13
Error	218	6.49	
UI:			
Sex	1	.00	.00
Grade	4	140.23	4.24***
S x G	4	51.21	1.55
Error	218	33.08	
Time:			
Sex	1	110.54	1.94
Grade	4	150.53	2.64**
S x G	4	54.38	.95
Error	218	56.96	

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

**$p \leq .05$
***$p \leq .01$

TABLE 15

ANALYSIS OF MEANS OUT OF GRADE SEQUENCE

Score	Grade	Mean[a]	n	Comparison			
				Grades	Difference	Sp[b]	t
SQ:							
Grade Out of Seq.	3	1.5	60				
Next Higher Grade	4	1.4	67	3-4	.1	1.32	.45
Last Higher Grade	5	1.4	31	3-5	.1	1.36	.33
QA:							
Grade Out of Seq.	3	3.9	60				
Next Higher Grade	4	2.7	67	3-4	1.2	2.67	2.73***
Last Higher Grade	5	3.0	31	3-5	.9	2.88	1.43*
UI:							
Grade Out of Seq.	3	7.6	60				
Next Higher Grade	4	4.9	67	3-4	2.7	5.63	2.81***
Last Higher Grade	5	6.1	31	3-5	1.5	6.42	1.06
Time:							
Grade Out of Seq.	3	14.2	60				
Next Higher Grade	4	10.6	67	3-4	3.6	8.02	2.65***
Last Higher Grade	7	14.0	35	3-7	.2	7.74	.12

[a] From the "Boys and Girls" column of Table 13

[b] Pooled standard deviation

*p ≤ .10
***p ≤ .01

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

The distributions of reading and group-administered intelligence test scores are presented in Figure 19. The correlations of the reading and intelligence scores with UI and inquiry time are shown in Table 16. As can be seen readily, intelligence level had no determining effect on search behavior and time. Although intelligence scores had no effect on time, there was a slight, but significant, negative relationship between reading level and time spent inquiring. To a small degree, the lower a child's reading level, the more time he spent inquiring. There was also a very slight positive relationship between reading level and UI.

The grand means for a single unit of work and the intercorrelations of the inquiry scores are presented in Table 17. The table presents data similar to those presented in Chapter 3, but here the means are for a single unit of work, rather than for ten units per individual (cf. Figure 4A). The mean scores were all higher for this first unit of work; for UI the mean was twice that shown earlier. This factor will become relevant in the following experiments when the effect of teaching on the inquiry scores is measured. It should simply be noted for now that inquiry scores tended to drop after the first unit of work. The correlations among SQ, QA, and UI were all lower than they were for means of ten units of work. Comparing also with Figure 4B, this is true with one exception (QA and UI, Middle Inquiry Time) for the correlations obtained for the scores within subgroups. The correlations between time and the inquiry scores are similar, but here they have a smaller range. The relevance of the correlation levels to the independence of the scores is explored in the following discussion.

Discussion

Do children as they get older tend to have higher inquiry scores? The question was answered by comparing the scores in terms of grade levels, and the answer is generally yes. Although the increases were not large from grade to grade, they were consistently higher from fourth through seventh grade and the end points of the range were significantly different. In contrast, third-grade scores were significantly out of sequence. The conflict of the third-grade scores can be resolved if they are viewed as evidence for some degree of the

FIGURE 19

DISTRIBUTION OF READING AND GROUP INTELLIGENCE TEST SCORES FOR SUBSAMPLE (n = 95)

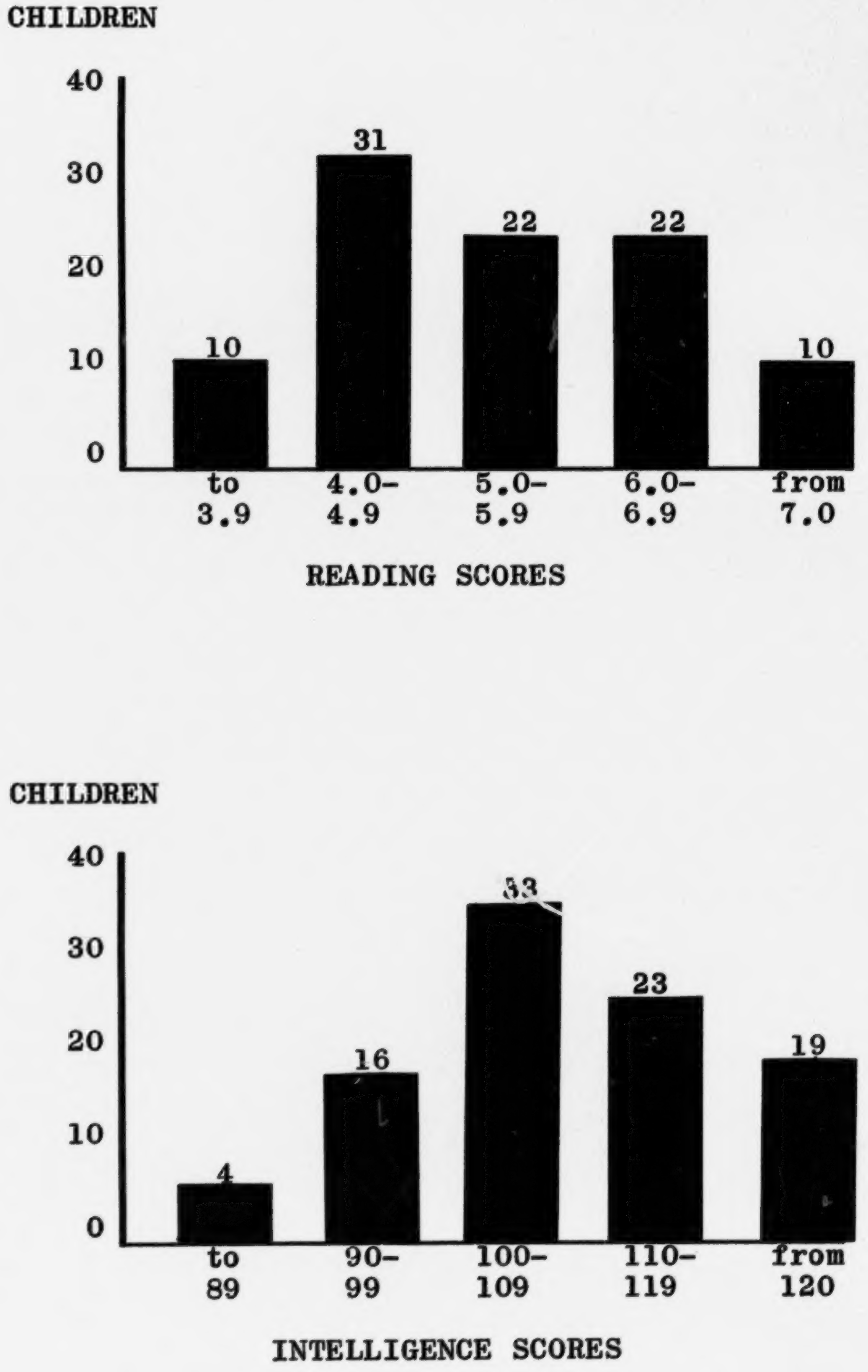


TABLE 16

CORRELATIONS OF READING AND GROUP INTELLIGENCE TEST SCORES WITH UNITS OF INFORMATION (UI) AND TIME[a]

Score	Reading	Intelligence
UI	.14	.01
Time	-.21	-.08

[a] UI and time based on one unit of work (unit 100).

Note: For $n = 95$, $p \leq .10$ when $r \geq .13$, $p \leq .05$ when $r \geq .17$, and $p \leq .01$ when $r \geq .24$.

TABLE 17

GRAND MEANS FOR ONE UNIT OF WORK[a] AND INTERCORRELATIONS AMONG INQUIRY SCORES

			Correlations		
Score	Mean	S.D.	SQ	QA	UI
SQ	1.6	1.30	—		
QA	3.5	2.60	.69	—	
UI	7.0	5.92	.53	.85	—
Time	12.4	7.65	.53	.67	.62

[a] Unit 100

N = 228

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

nondetermining effect of age. This interpretation is consistent with impressions obtained during pilot experimentation that the older the children the higher the inquiry scores but that class groups occasionally had scores that were out of sequence. It was interesting that the out-of-sequence scores seemed to be associated with the children of specific classes as if particular group experiences might change inquiry activity. In a study of first, third, and fifth grade children, Berlyne and Frommer (1966) also found evidence that the incidence of question asking generally increased as a function of the children's grade level. The task in their research involved exposure to stories and pictures, and the children were invited to ask questions. It is interesting to note that in the first out of two experiments the third-grade children asked the greatest number of questions. In the second experiment, the third-grade children asked as many questions as the fifth-grade children overall, but they asked more questions when provided with answers than either of the two other age groups. The third-grade scores were not regarded as freak results, their consistency precluded such a conclusion, but no explanation was suggested. Given the results of the present study, one can only wonder whether there is characteristically more openness to question asking in third-grade children. A detailed analysis of their data, though, permitted them to conclude that age is an important factor with regard to the incidence and content of questions. The findings taken together are interpreted as supportive of the determining effect of age, but also supportive of the need for future research to investigate potential overriding factors.

What is the relationship of inquiry scores to sex differences, reading levels and a group measure of intelligence? The question of sex differences was answered by analysis of variance; none was found. The correlations of measures of search behavior and time with measures of reading and intelligence obtained very low values suggesting little or no relationship. Only the correlations with reading were significant; it is evidence for slight negative effect of reading level on inquiry time and a corollary effect on search. The relationship is intuitively understandable, yet not large enough to detract from the meaning of these measures of inquiry activity. With regard to time, Shulman (1965) found significant correlations with tests related to closure-flexibility, risk, uses, word association, and mathematics. With regard to his measure of general inquiry, he found significant correlations with the same tests, with the exception of uses and word association. Shulman concluded that his findings showed the association of cognitive style predictors as well as aptitude predictors to inquiry scores. One "aptitude" predictor in the present study, intelligence level, was not related to the children's search behavior scores or to time spent inquiring. Analogous to Shulman's findings, time spent inquiring and search were slightly affected by reading level. (Cognitive style predictors will be explored in the next chapter.) It was interesting to observe that some of the children who had low reading ability seemed to be unusually motivated by the Mayor task. This may account for the finding of the very low relationship between search behavior and reading level. Since the test of intelligence is essentially a test of convergent thinking, it was expected not to relate to inquiry scores. It may be that children's inquiry processes are much less affected by aptitude than are the inquiry scores of adults as they were for teacher-trainees in Shulman's study.

These data are a start toward understanding the validity of the inquiry scores. It appears that what the children are doing is inquiry by definition. If scores obtained by measuring the behavior are valid, then they would necessarily not be predicted by noninquiry measures. The inference is consistent with the fact that third grade children obtained scores that were out of sequence for their grade level. In a sense, the task and associated measures may be suitable validating criteria for simpler measures of cognitive style and inquiry behavior.

When considered in terms of a single unit of work instead of ten units of work, the independence of the scores is increased. The correlations are now more in line with those of Shulman. He found that problem sensitivity versus time correlated .79, and versus information sources, .76, and time versus information sources correlated .60. A correlation of .53 of our measure of problem sensitivity (SQ) and time suggests even a greater degree of independence of these scores for the children. It is not possible to know whether it is due to a difference in age, a difference in the tasks, or a difference in the way the measures are made. It is obvious that the inquiry measures are related and the relationship is consistent with their theoretical basis. The independence of the measures, though, can only be considered in terms of degrees, and the degree of independence would seem to be variable. Data with regard to the possibility that they are related to different mental processes would have to be differentially collected so that one score might be affected while not affecting others. This problem will need to be explored in future studies.

In sum, it has been found that inquiry scores for mesaures of problem sensitivity (SQ), problem formulation (QA), search behavior (UI), and time can be obtained for children from third through seventh grade. The scores tended to increase with grade level, but an individual grade level can be very much out of the pattern. The independence of the scores was considered from two viewpoints. The scores were independent of sex differences and intelligence level as measured by a group test; there was evidence for a slight effect of reading level on search and length of time spent inquiring. The scores are highly correlated with each other, but have a degree of independence that makes their individual measurement potentially important.

Chapter 5

TEACHING METHODS AND ENVIRONMENTS[1]

Experiment I

The purpose of this experiment, intended mainly as a pilot study, was to test specific methods of the teaching of inquiry. Secondarily, the purpose was to determine the conditions under which the methods could best be used. The first of the two movies, the two programed texts, and the two discussion plans described in Chapter 2 were used in the following experiment. The general attempt was to find any viable methods for the teaching of inquiry and not to demonstrate that one method is better than any other. The relevant question was whether a movie, programed texts, and/or discussions designed to teach problem sensitivity and problem formulation could successfully be used in the teaching of inquiry skills. The criterion was significant increase in inquiry activity.

The teaching methods were used under two conditions. First, the method of teaching was assigned to the student; one experimental group was taught with a programed text, another by discussion. Second, the students were allowed to rank the methods by which they wanted to be taught and were assigned to their experimental groups on the basis of their choices. One experimental group was taught in a discussion group, the other chose an individualized instruction group. The children in the latter group, after seeing the movie, individually chose between programed texts and discussion. The relevant question was whether the conditions changed the effect of the teaching methods. Underlying the question was the theory that inquiry activity is most affected by teaching which is made available in an environment. It was expected that the highest elevations in inquiry activity would result in the groups with the greater degree of choice.

The children played Mayor and were taught on alternate days over a week's time for five periods. Each period allowed fifty minutes. Altogether, they played

---

[1] Parts of this chapter were presented in a paper at the American Educational Research Association meeting, Chicago, February, 1968, entitled "The teaching of inquiry skills to fifth-grade children" with Hedy Zussman, Donald R. Dutter and Edward S. Jurowski.

Mayor for three periods every other day and attended two teaching sessions on the intervening days (shown in Table 18A). The sample included 20 fifth-grade children, 9 girls and 11 boys (see Table 18B). All of the subjects were from the one southwestern Ohio elementary school. Each experimental group included four subjects. The children were members of classes assigned to participate in the experiment; they were randomly assigned from stratified pools to balance the groups. The variables of stratification included sex and creativity test scores. The purpose of the stratification was to overcome problems associated with small experimental subsamples by making the groups as comparable as possible. No significance was attached to the particular matching variables used. Moreover, this method did not successfully equate the initial inquiry scores of the children. This problem was dealt with by the method of analysis and is discussed below.

The inquiry scores obtained were the same ones used in the previous studies. In this experiment, though, no additional information was gained from the measures of the problem sensitivity and problem formulation and therefore only the scores for search behavior (UI) and time spent inquiring are reported. It was originally intended that the sensitivity and formulation scores would reflect the particular effect of the problem sensitivity and problem formulation teaching programs, but the pilot testing for these experiments immediately revealed that any such hopes were misguided. As yet, the measures are not sufficiently sensitive nor the effects large enough to register subtle changes on individual scores as a result of specific content. Since the experimental groups did not have comparable starting scores, the data are reported in terms of cumulative change scores, i.e., elevations in UI and time that occurred from the first unit of the Mayor's Work to the last unit.

The instructions were administered by means of a movie (see Chapter 2). Each child had a booklet containing the specific examples used in the movie, and a few minutes were allowed for questions at the end. The children were then introduced to their secretary-experimenters who took them to their carrel and told them the number of the unit of work that was waiting for them. The procedure for collecting data was the same as in the two previous studies. Teaching, the independent variable, was introduced at the same point in terms of the unit of work for every child in each

TABLE 18A

DESIGN OF EXPERIMENT I

Day	Activity[a]
1	Unit 107 of The Mayor's Work
2	Teaching Condition
3	Unit 101 of The Mayor's Work
4	Teaching Condition
5	Unit 104 of The Mayor's Work

[a] Fifty minutes were allowed each day.

TABLE 18B

SAMPLE SIZE FOR EXPERIMENT I

	No Student Preference		Student Preference			
	PT	Disc	Disc	II	Control	Total
Boys	2	3	2	2	2	11
Girls	2	1	2	2	2	9
Total	4	4	4	4	4	N = 20

PT: Programed Text
Disc: Discussion
II: Individualized Instruction

experiment. Conditions of teaching were varied as part of the characteristics of a particular teaching method. The control group left class for the same amount of time as the experimental groups and played school games.

It was hypothesized that any of the teaching methods under either condition would result in some increase in inquiry activity. It was hypothesized that the condition allowing for the most student direction would result in the highest increases in inquiry activity. The general aim of this experiment was to determine methods and conditions of teaching that would allow for a viable comparison of methods in the following experiment.

Results

The mean cumulative changes for Experiment I for UI and time and their standard deviations are shown in Table 19. Cumulative mean change is equivalent to subtracting the score for the initial unit of work from the score for the last unit of work. Since the initial scores and last scores were for the same individual, the significance of the difference was tested as a paired comparison (cf. Dixon & Massey, 1957, pp. 124-127). A mean difference of at least two search behavior units ($UI \geq 2$) and two minutes ($time \geq 2$) were defined as necessary for practical significance. None of the increases were significant, and notice that in some cases the means were negative. For this reason, no further analyses were done.

It should be pointed out that these results are similar to those obtained without the introduction of teaching. In the earlier studies, we saw that the mean scores for the initial unit of work were higher than all subsequent mean scores. As would be expected, the scores for the control group showed this tendency, but it also occurred for some of the experimental groups' scores. Before it would be possible to obtain significant increases, it was necessary to overcome the tendency for the scores to become lower. In some sense, where the scores did not decrease can be considered a positive indication that the teaching was having some effect.

What is the effect of the different teaching methods? Two teaching sessions using programed instruction, discussion, or a movie did not result in significant increases in inquiry activity. The second conclusion must be that there was no dependable effect due to use

TABLE 19

ANALYSIS OF MEAN CUMULATIVE CHANGE AS A FUNCTION OF TEACHING METHOD

	No Student Preference		Student Preference		
Score	PT	Disc	Disc	II	Control
UI:					
Change[a]	2.0	5.0	-6.2	1.5	-2.2
S.D.[b]	5.83	5.60	2.06	2.65	13.33
df	3	3	3	3	3
t[c]	0	1.07	-7.96	-.38	-.63
Time:					
Change[c]	-1.2	4.8	-4.9	1.7	-6.0
S.D.[b]	7.15	5.65	1.26	3.58	15.55
df	3	3	3	3	3
t[c]	-.89	.99	-10.95	-.17	-1.03

UI:	Units of Information
Time:	in minutes
PT:	Programed Text
Disc:	Discussion
II:	Individualized Instruction

[a] The change is the cumulative mean increase from the first unit of work to the last.

[b] S.D. is the standard deviation of the change scores for the individuals in each experimental group.

[c] The t-value is derived in an adaptation of a manner presented by Dixon and Massey (1957, pp. 124-127) for paired comparisons:

$$t = \frac{D - LPS}{S.D./\sqrt{n}},$$

where D = cumulative mean increase
LPS = level of practical significance, for UI $\geqq 2$, for time $\geqq 2$
S.D. = see b
n = number of difference scores, here, n = 4

of the methods under two conditions: assignment or choice. The effect of the discussion when viewed under two conditions was variable. The individualized instruction group's scores at least did not decrease, but under the condition where the students were assigned to the discussion group, the scores also did not decrease.

In general, we had originally thought that individual teaching methods were part of a teaching environment when the students were allowed to choose how they would be taught. Positive results in this experiment would have supported this view and it would have been possible to move systematically into the design of Experiment II. In contrast, the overall negative results required an extensive reconceptualization of the operational definition of a teaching environment. Up to this point, we had thought that just the possibility of choice was critical. Thinking about the problem after the data had been collected and analyzed, it seemed likely that the materials needed to be more available--on a continuous basis. Such a condition would exist if the materials were simultaneously available in a learning center; it would then be possible for the students to effectively make many more choices according to how and if they wanted to be taught. These ideas led to the design of Experiment II.

Experiment II

The first purpose of this experiment was to determine whether fifth-grade children can be taught to increase their inquiry activity through the use of an environment designed to teach inquiry skills. Our intention was to reverse the findings of the previous experiment by working with a larger sample of children and radically changing the method and amount of teaching. Following the theory outlined in Chapter 1, it was expected that the use of the teaching materials in a learning center would have a significant effect on inquiry activity. The second purpose of the experiment was to determine whether the degree of structure in terms of teacher direction in the same environment would have a differential effect on inquiry activity. The final purpose was to explore the possible relationship between inquiry scores and scores on school-administered creativity tests.

The difficulty with obtaining a large sample was finding the space of a classroom and constructing a relatively permanent learning center. In a pilot study with only three children, it was possible with six experimenters to create the environment each day as one would set up a stage for a play. The problem was solved by a highly cooperative arrangement with one of the participating schools near Chicago. As part of its own innovative program, three learning centers had been developed and were already in use. For the duration of the experimentation, one of the centers, the social studies learning center, was converted to a Mayor's Conference and six Mayor's offices. The data collection took place in two series of two weeks each in a period of two months. During this time, the Mayor's Conference could be made available throughout any school day, when a teaching day was called for by the design of the experiment. For this experiment the independent variable was participation in a learning center.

The degree of teacher direction in the learning center was relatively easy to manipulate; two degrees were designed. The least teacher direction took place in an "open environment" by telling the students that while they were at the Mayor's Conference they could do whatever they wanted to do (essentially, student direction). The most teacher direction took place in a "structured environment" by scheduling the presentation of the teaching methods as they would be in an ordinary classroom situation. It was expected that the effect of the open environment on inquiry activity would be greater than the effect of the structured environment but that both environments would significantly elevate inquiry activity.

In Chapter 4, it was shown, with the exception of the slight relationship of reading level, that there was no relationship between background and aptitude variables, and inquiry variables. These results are not consistent with those of Shulman (1965); it was proposed that the differences may be accounted for by the difference in age of the subjects. It remained of interest to investigate whether other measures related to inquiry measures. Shulman found that Thurstone's Flexibility of Closure related significantly with problem sensitivity, information sources, and time and that a measure of risk and a "uses" test score were significantly related to problem sensitivity and time. It was expected in the present study that generally supporting evidence would be found although no theoretical framework was used to make specific hypotheses.

For the two experimental treatments, the children attended the same learning center, called the Mayor's Conference (see Chapter 2). The same learning center director was present at all times, but she played different roles to effect the two experimental conditions. In the structured environment, she acted much like a classroom teacher, telling the children when and what to do. In the open environment, she introduced the materials in the first few minutes of the first session and then made herself available to lead a discussion when requested, run the projector and keep materials in some general state of order. For the control condition, the children attended one of the school's regular learning centers where none of the inquiry materials were available.

The design of the study is shown in Table 20A. The children participated in subgroups of 6 subjects each in two series. Two subgroups of the open environment, 1 subgroup of structured environment, and 1 control subgroup were run in the first two week period; the remainder were run in the second two week period. The study included 54 children in fifth grade (see Table 20B). In contrast to the children in Experiment I, all of the children had played Mayor for one session either one year previously as part of the study reported in Chapter 4 or two weeks prior to the experimental trials in which they participated. Care was taken to insure that no child had worked a unit that would be part of the present study. The population of children from which the subjects for the study were chosen included all of the

TABLE 20A

DESIGN OF EXPERIMENT II

Day	Activity[a]
1	Unit 105 of The Mayor's Work
2	Teaching Condition
3	Unit 106 of The Mayor's Work
4	Teaching Condition
5	Unit 107 of The Mayor's Work
6	Teaching Condition
7	Unit 108 of The Mayor's Work

[a] Fifty minutes were allowed each day.

TABLE 20B

SAMPLE SIZE FOR EXPERIMENT II

	Experimental Environment			
	Open	Structured	Control	Total
Boys	8	9	8	25
Girls	10	9	10	29
Total	18	18	18	N = 54

fifth-graders in the one school. On the basis of their earlier scores, children with exceptionally low scores were excluded; the remainder were placed in groups to obtain maximum matching on sex, and scores for problem sensitivity and problem formulation. The groups were randomly assigned to treatments.

The instructions were administered in the same way as they were in Experiment I with a movie repeated for each of the subgroups. Each child who had not played Mayor two weeks previously was directed to play for 15 minutes on a nonexperimental unit of work immediately after seeing the instruction movie. The subgroups came at the same time of day for the duration of experiment, and the time of day was balanced for treatments. The experiment was planned to include the last units of the Mayor's Work starting with 105, because it appeared from the previous research that they obtained the most similar scores. It was originally planned to also include the data from one additional teaching day and unit 109, but the school's program interfered with the experimental procedures and invalidated the data. The method of data collection was the same as in all previous studies, although in the present experiment a more successful effort was made to have the same secretary-experimenter for each child for the duration of the experiment.

The scores (SQ, QA, UI and time) were computed in the way that they had been for all previous studies. For the purposes of measuring the effect of the teaching environments and insuring that the groups' scores would be comparable, change scores between units of work and cumulative change scores were computed, as they were in Experiment I. The scores for creativity were taken from the school records; the tests used were adapted from Torrance (similar to those reported in Torrance, 1962) and had been administered prior to the period of experimentation. Scores were reported for fluency, originality elaboration, and flexibility and were based on four tests. The tests included drawing pictures in a field of circles, generating questions, causes, and consequences for a picture, thinking of ways to change a toy dog, and generating uses for a tin can.

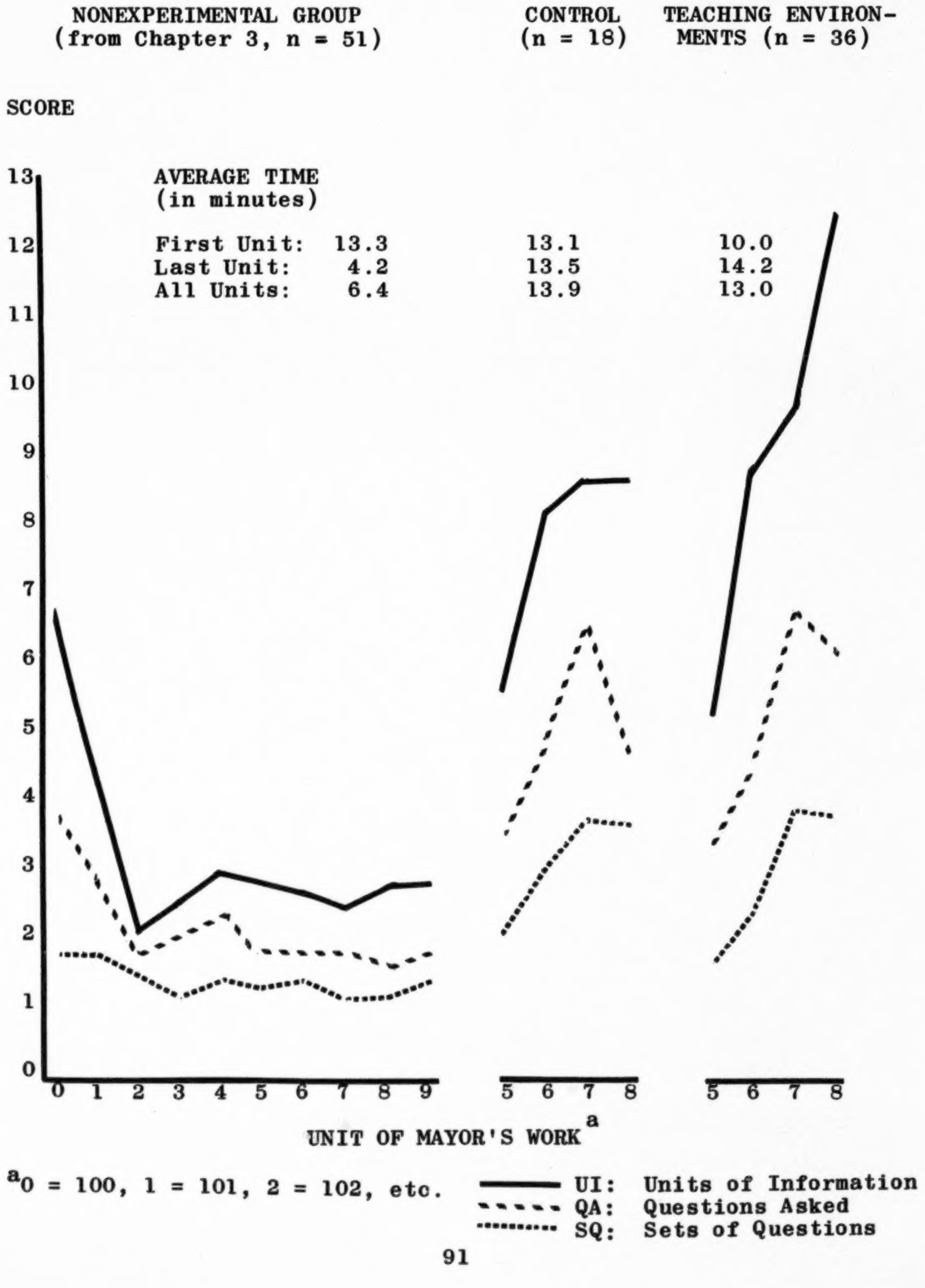
The effect of teaching was defined in two ways. Similar to the method of Experiment I, cumulative change was tested as a paired comparison for significant elevation. It was hypothesized that the changes would be significant for the structured and open environments. On a post hoc basis, practical significance was set at one unit for problem sensitivity (SQ ≧ 1) and problem formulation (QA ≧ 1), two units for search behavior (UI ≧ 2), and two minutes (time ≧ 2). Secondly, to test for the differential effect of treatments, an analysis of variance was made using orthogonal comparisons (cf. Snedecor, 1956, pp. 330-333). It was hypothesized that the mean cumulative changes for the open and structured environments would both be greater than the control means for the measures of sensitivity, formulation, search, and time, and that the means for the open environment would be greater than those for the structured environment. The relationship of creativity scores and inquiry scores was explored by means of a correlation matrix.

Results

The mean scores obtained on units of the Mayor's Work for nonexperimental subjects (reported in Chapter 3) are compared with the scores obtained in the present study in Figure 20. The shape of the nonexperimental curves graphically demonstrates the pattern of inquiry for children who are measured over an extended period without the introduction of an independent variable. In general, the scores were highest on the first units of work and leveled off for the remainder. The drop causes negative scores when mean change scores are used. It is for this reason, apparently, that the ineffective teaching in Experiment I resulted in some negative change scores, i.e., the first experiment did not basically alter the pattern found in nonexperimental subjects. Looking now to the curves for the combined means of the groups who participated in the open and structured learning center (and the control curves), the teaching environments were clearly effective. For SQ and QA, there was a pattern of steady increase over three units of work and then they leveled off. The elevation of search behavior was dramatically increased. The results for the control group are also of special interest. It would have been no surprise if the control group scores had been similar to the scores for the average of the nonexperimental children for the same units of work. Also, why do the control and the environment groups' mean scores all start higher than the "control" scores from the nonexperimental group? Apparently, as first units of work in a series, they followed the expected pattern to start high, control and treatment groups alike. It is suggested that the control scores did not characteristically fall because of a Hawthorne effect created by the special learning center used for both the Mayor's offices and the Mayor's Conference--even though the control children did not participate in the conference experiences.

FIGURE 20

A COMPARISON OF THE INQUIRY ACTIVITY OF NONEXPERIMENTAL AND EXPERIMENTAL GROUPS



AVERAGE TIME (in minutes)

	Nonexperimental	Control	Teaching Environments
First Unit:	13.3	13.1	10.0
Last Unit:	4.2	13.5	14.2
All Units:	6.4	13.9	13.0

[a] 0 = 100, 1 = 101, 2 = 102, etc.

The next critical question was whether the elevations for the structured and the open environments represented significant increases. The mean cumulative change scores for SQ, QA, UI and time are given for each of the experimental groups in Table 21 and for purposes of comparison they are shown in Figure 21. The t-values are for paired comparisons using scores for the first and last unit of work and were computed in the same manner as they were in Experiment I. Except for time spent inquiring in the open environment group, all elevations were significant for the teaching groups; none of the elevations were significant for the control group. Making two orthogonal comparisons in a manner suggested by Snedecor (1956), the relative increases among the experimental groups were clarified by an analysis of variance (see Table 22). None of the comparisons for SQ or QA was significant. The increases for the teaching groups were significantly greater than for the control groups on UI and time spent inquiring. In no case were the scores for the children of the open environment significantly different than those for the structured environment.

The results of a comparison of the variances of the three groups are presented in Table 23. The variances were compared for groups on the last unit of work in order to allow for the maximum effect of the two different environments. In contrast to the analyses of mean cumulative changes, there were significant differences between the open and structured environment groups. For SQ and QA, the variance for the open group was significantly greater than the variance for the structured group. As a further indication of the effectiveness of both the environments for teaching, the variance for the open group for QA and UI, and for the structured group for UI, was significantly greater than that for the controls. An overall view of the cumulative changes that occurred in this experiment can be seen in Figure 21. All of the change scores are in positive regions of the graphs. Consistent with the hypothesis--although it has already been shown that the differences were not significant--it is interesting that the greatest change was for SQ, QA, and UI in the open environment. Contrary to the hypothesis, the elevation of time was greatest for the structured environment.

Correlations of creativity scores and inquiry scores are presented in Tables 24 and 25. In order to facilitate a comparison with results obtained by Shulman (1965), statistical significance was set at $p \leq .05$. As an

TABLE 21

ANALYSIS OF MEAN CUMULATIVE CHANGE AS A FUNCTION OF TEACHING ENVIRONMENT

	Teaching Environments		
Score	Open	Structured	Control
SQ:			
Change[a]	2.3	1.7	1.6
S.D.[b]	3.50	1.71	2.81
df	17	17	17
t[c]	1.56*	1.80**	.92
QA:			
Change[a]	3.4	2.2	1.2
S.D.[b]	5.79	3.08	3.04
df	17	17	17
t[c]	1.78**	1.67*	.31
UI:			
Change[a]	7.7	7.2	2.9
S.D.[b]	10.02	8.06	5.03
df	17	17	17
t[c]	2.42**	2.72***	.75
Time:			
Change[a]	3.5	4.9	.4
S.D.[b]	8.43	7.65	6.69
df	17	17	17
t[c]	.75	1.61*	-1.01

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

[a] The change is the cumulative mean increase from the first unit of work to the last.

[b] S.D. is the standard deviation of the change scores for the individuals in each experimental group.

[c] For a complete explanation, see Table 19, note c.

$$t = \frac{D - LPS}{S.D./\sqrt{n}},$$

where D = cumulative mean increase
LPS = level of practical significance, for SQ $\geq$ 1, QA $\geq$ 1, UI $\geq$ 2, and time $\geq$ 2.
S.D. = see b.
n = number of difference scores, here, n = 18

*$p \leq .10$
**$p \leq .05$
***$p \leq .01$

FIGURE 21

MEAN CUMULATIVE CHANGES FOR THREE ENVIRONMENTS

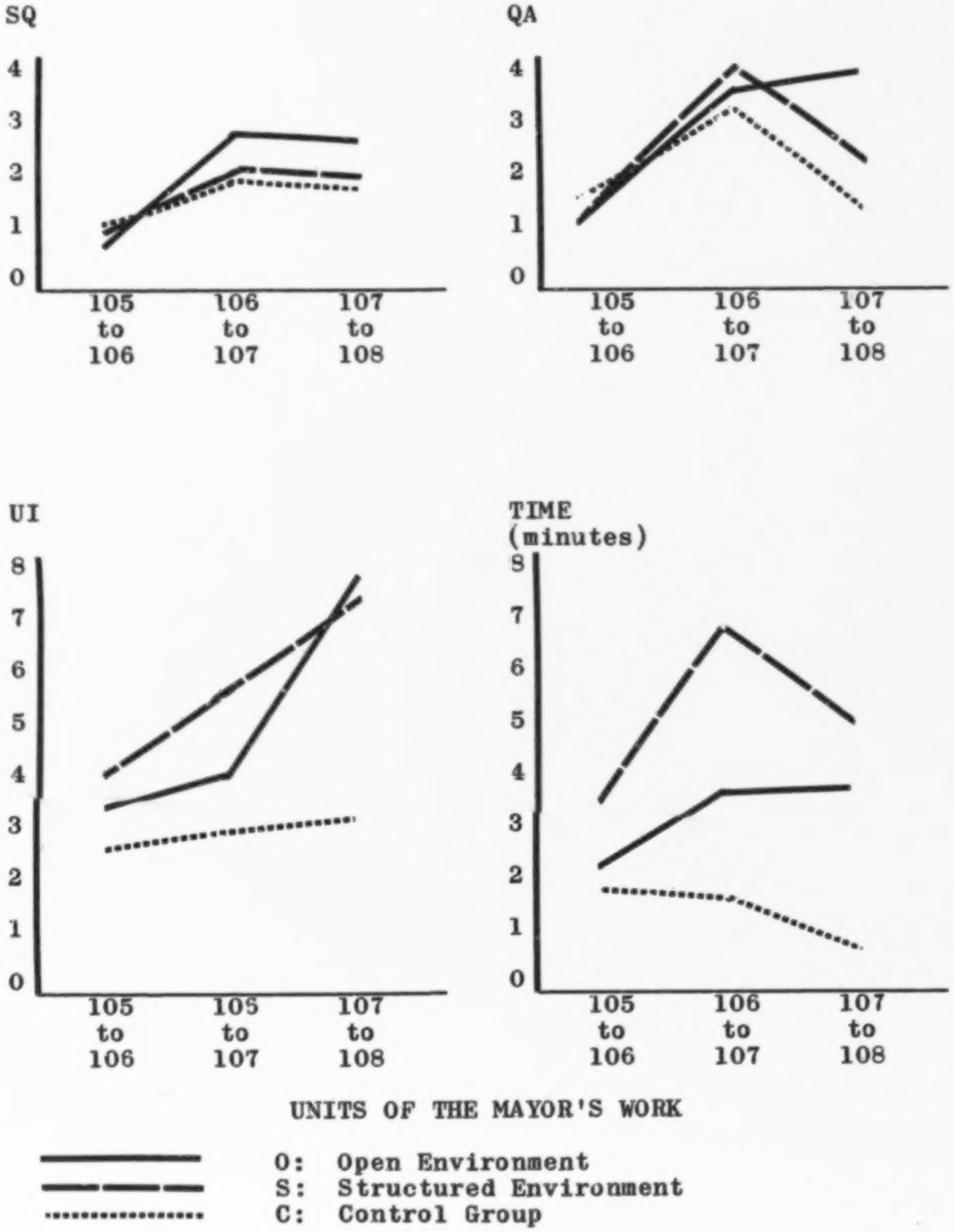


TABLE 22

ANALYSIS OF VARIANCE AND ORTHOGONAL COMPARISONS[a] FOR MEAN CUMULATIVE CHANGE SCORES FOR ENVIRONMENT GROUPS

	Teaching					
Score	O	S	C	df	MS	F[b]
SQ:						
Change	2.3	1.7	1.6			
Groups				(2)	(2.30)	
O+S vs. C	+1	+1	-2	1	1.81	
O vs. S	+1	-1	0	1	2.78	
Error				51	7.68	
QA:						
Change	3.4	2.2	1.2			
Groups				(2)	(22.30)	
O+S vs. C	+1	+1	-2	1	31.15	1.79
O vs. S	+1	-1	0	1	13.44	
Error				51	17.42	
UI:						
Change	7.7	7.2	2.9			
Groups				(2)	(125.91)	
O+S vs. C	+1	+1	-2	1	249.04	3.92*
O vs. S	+1	-1	0	1	2.78	
Error				51	63.53	
Time:						
Change	3.5	4.9	.4			
Groups				(2)	(96.66)	
O+S vs. C	+1	+1	-2	1	176.33	3.03*
O vs. S	+1	-1	0	1	17.36	
Error				51	58.13	

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

O: Open Environment
S: Structured Environment
C: Control Group

[a] The comparisons are derived in a manner presented by Snedecor (1956, pp. 330-333). The weights used in each comparison are entered in the table.

[b] F values less than one are omitted.

*$p \leq .10$

TABLE 23

A COMPARISON OF VARIANCE FOR INQUIRY ON THE LAST UNIT OF WORK[a]

	Teaching Environments			F		
Score	Open	Structured	Control	O/C	S/C	O/S
SQ:						
Mean	4.2	3.2	3.6			
Variance	10.05	4.04	8.58	1.17	.47	2.49**
QA:						
Mean	7.0	5.2	4.7			
Variance	24.80	10.05	12.67	1.96*	.79	2.47**
UI:						
Mean	13.4	11.8	8.7			
Variance	99.80	67.40	30.91	3.23**	2.18*	1.48
Time:						
Mean	13.42	15.1	13.5			
Variance	87.61	57.00	69.89	1.25	.82	1.54

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

O: Open Environment
S: Structured Environment
C: Control Group

[a] Unit 108

$*p \leq .10$
$**p \leq .05$

indicator of the predictive value of the creativity tests for inquiry scores unaffected by teaching, the inquiry scores were correlated with the first unit of work for all subjects (Table 24). The correlations, contrary to expectation, were uniformly low. Nine were of a magnitude of zero; six of the remaining seven were under .20. The initial inquiry scores were obviously not predicted by the creativity scores. This finding will be discussed in the following section in the light of other recent data.

TABLE 24

CORRELATIONS OF CREATIVITY SCORES AND INQUIRY SCORES FOR THE FIRST UNIT OF WORK[a]

	Creativity Scores			
Score	Fluency	Originality	Elaboration	Flexibility
QA	.09	.07	.16	.11
SQ	.06	-.01	.21	.15
UI	.01	-.05	.16	.13
Time	-.07	-.13	.04	-.08

QA: Questions Asked
SQ: Sets of Questions
UI: Unit of Information
Time: in minutes

[a]Unit 105

Note: For n = 54, $p \leq .05$ when $r \geq .22$.

As an indicator of the predictive value of the creativity tests for the effect of teaching environments on inquiry scores, they were correlated with mean cumulative change scores. The correlations for the teaching groups are shown as well as those for the control group as a means of comparison (Table 25).

TABLE 25

CORRELATIONS OF CREATIVITY SCORES AND INQUIRY SCORES FOR MEAN CUMULATIVE CHANGE FOR ENVIRONMENT GROUPS

Group and Score	Creativity Scores			
	Fluency	Originality	Elaboration	Flexibility
Open				
SQ	.23	.29	-.01	.04
QA	.10	.07	-.28	-.04
UI	.04	.04	-.30	-.02
Time	-.01	.09	-.24	-.04
Structured				
SQ	.28	.40	.40	.39
QA	.29	.39	.16	.25
UI	.35	.41	.31	.30
Time	.15	.30	.03	.14
Control				
SQ	-.27	-.28	-.10	-.40
QA	-.13	-.07	.03	-.23
UI	.16	.23	.19	.08
Time	-.03	.15	-.08	-.02

SQ: Sets of Questions
QA: Questions Asked
UI: Units of Information
Time: in minutes

Note: For $n = 18$, $p \leqq .05$ when $r \geqq .40$, and $p \leqq .01$ when $r \geqq .54$.

Similar to the first set of correlations, they were all quite low for the open and control group. For the control group, one value is equal to the criterion level, but it is negative. Even so, one significant correlation out of 16 is consistent with the set level of probability. The correlations of creativity scores and inquiry change scores for the open group were entirely consistent with the findings for the combined groups. Unexpectedly, the correlations for the structured environment group, for scores on SQ, QA and UI, were uniformly higher than any of the others found. With one exception, all were .25 or greater. Considering all of the correlations in each matrix, the average for the open group is .00, and for the control group, -.05; whereas for the structured group the average is .28. The score for originality was significantly correlated with the measures of problem sensitivity (SQ) and search behavior (UI), and the score for elaboration was significantly correlated with the measure of problem sensitivity (SQ).

Discussion

Can a learning center environment designed to teach inquiry skills effectively increase inquiry activity? On the basis of tests for significant increases between the starting and final scores for experimental groups, and consistent with the hypothesis, all scores were elevated with one exception. It seems from the trend of the data that the exception could be significantly elevated by continued experimentation and that it is not a qualitative difference. On the basis of the analysis of variance, considering the experimental groups versus the control group, only two of the four were significant. But all of the mean change scores are in the predicted relationship to each other, and this fact by itself argues for the general effect of the environments. A reasonable conclusion is that the use of the learning center environments as methods of teaching has effectively, although not unequivocally, increased inquiry activity. Considering the graphic view in Figure 21 and the results of the t-tests and the F-tests, units of information as a measure reflecting search behavior was one score that was clearly elevated from all viewpoints.

The general elevation of the control group scores over the scores obtained for nonexperimental conditions, and the suggested Hawthorne effect, point to further evidence about the effect of environments on inquiry activity. The overall picture of the control scores in comparison to the nonexperimental scores and the lack of significant differences for the measures of problem sensitivity (SQ) and problem formulation (QA) suggests that the increased activity of the experimenters in the school had the effect of another "teaching environment." It may well be that the setting up of a learning center, and having the control children play Mayor in the center, alone accounts for the elevation of the control group scores over those obtained for nonexperimental subjects. In essence, the environment of the center without the opportunity to use the materials might be itself conducive to increased inquiry activity.

Viewed generally these results are consistent with those of Suchman (1962) and help to explain some of his equivocal results. Considering the data for five schools, he found significant increases in conceptual growth for both the experimental and control subjects, and similarly the difference between the two groups was not significant. Suchman's methods involved inquiry training over a period of 24 weeks. It is easy to imagine that the presence of the experimental program and new materials changed the educational environment. Although there were no significant differences for scores on the "informational yield of inquiry", his methods were generally successful in their attempt to increase inquiry activity. The experiments involved teachers directly requiring children to ask questions about unexplained phenomena. Using a fluency score, Suchman found that the inquiry group asked significantly more questions than the control group, a difference greater than 50 per cent. This result is analogous to the significant increases in question asking as measured by QA for the open and structured environments. (For the present study, these mean increases are not significantly different than those of the control group, but this problem has already been discussed in terms of the potential effect of any environment including that of the control.) In relative terms, the number of questions for the children in the structured environment increased nearly twice that of the controls, and the number for the open environment increased nearly three times that of the controls. The fact that the search behavior score (UI) was the one score that was unequivocally elevated in the present study may be due to the more general approach to the teaching of inquiry used. Significant increases in the measures of problem sensitivity (SQ) and problem formulation (QA) in the experimental groups, although not significantly different from the control group, may have facilitated the significant differences for search behavior (UI).

What is the differential effect of structured versus unstructured teaching on inquiry scores? From the viewpoint of the usually acceptable criterion, the analysis of variance, there was no differential effect on any of the scores. In contrast, it was shown graphically in Figure 21 that the greatest cumulative mean changes occurred for the children of the open environment, with the exception of time. Also, consistent with the greater variability of the inquirers shown earlier, the variance of the open environment group was significantly greater than the structured environment group for the measures of problem sensitivity (SQ) and problem formulation (QA). The evidence, particularly with regard to differences in variability, suggests that there may have been differential effects, but only further research will be able to clarify the contrasting results. Particularly puzzling are the results for time. (Earlier it was shown that reading level can effect time, but checking the means and distributions of reading scores for the three groups showed that they are nearly identical.) No interpretation is offered to explain the data on time spent inquiring except to recognize that the difference between teaching environments was not significant.

Significant differences in variance between the environments and the controls again point to the overall effect of teaching; for search behavior (UI) they are significant for both environments. The results in general suggest a simple conclusion: the environments equally effected an increase in inquiry activity. On the basis of this conclusion, a new hypothesis is suggested with regard to differential teaching environments. It may be that the teaching environments in this study should not have resulted in overall differential effects, because the addition of teacher direction in the learning center environment was not sufficiently significant a factor to decrease inquiry activity--and unnecessary for increasing the effectiveness of the environment.

An implicit assumption is made in research on the differential effectiveness of teaching methods, i.e., that teaching facilitates students' learning. As pointed out in Chapter 1, though, developments in recorded communication for education have expanded the concept of teaching. To traditional methods of teaching are added the potential effects of audiovisual communication, programed teaching, learning centers, and independent learning programs. The effect of the assumption is unclear.

It is necessary to question in research on teaching methods whether traditional teaching is at all critical for a particular set of objectives. As early as 1928, Greene showed that college students can learn as well from reading information as they can from listening to a lecture on the same material. Beach (1962) found no differences in achievement in research on instructorless groups, and Ketcham and Heath (1963) found no differential effect between repeated showings of a film and a classroom presentation. Allender,Bernstein, and Miller (1965) reported no differences for three schools for programed test, teaching machines, standard text and lectures (with one exception) to medical students, and Gulo and Nigro (1966) reported no differences for teaching elementary statistics by programed, television and conventional textbook instruction. In light of the revised hypothesis and the supporting evidence of these studies, the finding of no difference between the effect of the structured and open environments becomes important. For the teaching of inquiry, it appears that teacher direction in an environment designed to teach inquiry is unnecessary. Just how the imposition of greater structure might negatively affect inquiry activity is still an open question. Some decreases in variability were evident and suggest possibilities. But the study has provided additional evidence against the need for directive teaching, and positive information on the use of learning centers for teaching by only planning an environment.

What is the relationship of creativity scores and inquiry scores? In terms of the correlations for the first units of work and for change scores, none was found. The only set of correlations that evidenced any relationship were for change scores for the children who participated in the structured environment. No explanation can be offered for this slight exception to the general trend of no significant correlations. The main results are in direct conflict with expectations based on the findings of Shulman (1965). A recent study by Karlins (1967) suggests a possible explanation. He carefully differentiates conceptual systems theory and associative theory with regard to human problem solving and reports that tests generated by the two approaches have yielded a correlation of .01. Using an inquiry task involving the collection of data with regard to a community-development project in the South Pacific (college students as subjects), Karlins (p. 277) concludes, "The findings of the present investigation support the notion that subjects varying in conceptual level perform differentially in complex problem-solving situations . . . . There are no statistically significant behavioral differences between individuals varying in associate creativity in any aspect of the experimental problem studied in this investigation." The creativity scores we used are conceptually closer to the associative theoretical basis than to the information processing basis generated by the conceptual systems theory. The results for the two studies are therefore consistent and they are interpreted as supporting Karlins' theoretical position. The problem remains to explain Shulman's earlier results. In retrospect, it seems that the original hypothesis was naive and oversimplified; his measures of flexibility of closure and risk may be more closely related to conceptual systems than to associative creativity. Certainly though, the uses test which was part of Shulman's battery is a test of associative ability. The fact that Shulman's correlations are based on a sample including extremes in inquiring types could be critical to understanding the different results; from this standpoint all of his correlations may be spuriously high. Careful theoretical separation of the predictor measures will be necessary to clarify these equivocal findings.

In sum, an environment designed to teach inquiry significantly increased inquiry activity. There was a particularly consistent effect on search behavior scores. No differential effect was found between the structured and open environments, and this was interpreted as evidence that teacher-direction in the learning center was unnecessary for the teaching of inquiry skills. No general relationship, investigated by means of correlation, was found between scores on school-administered creativity tests and the measures of inquiry activity.

Chapter 6

GENERAL DISCUSSION AND CONCLUSIONS

In retrospect, one of the more intriguing findings was that children, when given the opportunity, engage in inquiry activity. Given a situation where decisions can be made but where no specific problems are given to be solved, the children we studied were generally interested and willing to inquire. They showed evidence that they sensed problems; they asked questions, and they requested information before reaching their decisions. In some sense it might be tempting to say, "Well, of course, that's the way kids are." The finding is important, though, when we consider that accepted learning theories require some kind of feedback to learn any response. In order for a child to learn to sense problems, ask questions and request information in the role as Mayor, it ought to be necessary to reinforce his behavior, to encourage him, or to otherwise provide consequences. No such feedback was available and yet, the majority of the children reported on (in Chapter 3) spent three or four forty-minute sessions engaged in inquiry activity. There was a great amount of individual variation in the inquiry behavior of different children, but the implication is fairly clear. Given the limits of the sample, the evidence points to intrinsic factors--within each child--which allow for problem sensitivity, problem formulation, and search behavior. Thus far the evidence is mostly quantitative; it was inferred that the children sensed problems, formulated problems, and found related information from the number of sets of questions requested, the number of questions used, and the amount of nonrandom data requested. Future investigations might be able to show even more clearly that independent inquiry activity, at various levels for different individuals, is a normal learning process when conditions are present that allow for it to occur. Such investigations will need to explore qualitative aspects of the inquiring process. For instance, information is needed on the kinds of questions children ask and how they relate to finding desired information. A reasonable conclusion at present is that middle elementary school children when given the opportunity will engage in independent inquiry activity.

It should not be implied from the discussion that individual differences are minimal. Groups differentiated on the basis of the average total time spent inquiring were characteristically different on the other inquiry scores. Corroborating the evidence found by Shulman (1963 and 1965) for different styles of inquiry, we found that children with the higher inquiry times had significantly higher inquiry scores on measures of problem sensitivity, formulation, and search. The scores were also significantly more variable. In terms of the present study, the implication is that some children inquire significantly more than others; it is not just that the children's styles of inquiry are different. The importance of inquiry level is related to its possible relationship to general functioning in a society. Shulman has shown that personality factors can help to account for differences. We have shown that different aspects of inquiry behavior are highly interrelated. But the critical unexplored question has to do with the relationship of levels of inquiry to successful attainment of goals--outside of the task used to measure inquiry. At present, it is possible to conclude (given the limits of the sample) that children can be meaningfully differentiated as to inquiry levels. In concrete terms, on the basis of inquiry time, the higher the level of inquiry, the more the tendency there is to sense problems, ask questions, and use information before reaching a decision.

The correlational analyses (in Chapter's 3 and 4) provide strong evidence that the inquiry processes are highly interrelated. Two critical qualifications are in order. First, when the data are analyzed in terms of whole groups over ten units of work, some of the correlations are sufficiently high to warrant wondering whether separate processes are being measured. Second, no evidence was obtained to show that the differentiated inquiry processes can be differentially affected by experimental conditions. The implication is that, although problem sensitivity, problem formulation, and search behavior may be intuitively very different processes, they may not be identifiably different. If they have actual independence, it will be important to understand how each functions, particularly in connection with the design of teaching materials. The degree to which the inquiry scores are not correlated offers some evidence for their independence. But to be able to demonstrate and understand each as a separate and important aspect of the inquiry process, it will be necessary to carry out experiments where each score can be varied systematically. It is concluded at present that we do not have good evidence that the inquiry processes theoretically identified--problem sensitivity, problem formulation and search behavior--are actually separate processes, but the evidence does argue for continued investigation. They are highly interrelated.

The relationship of the inquiry scores to other variables is varied (Chapter 4). No sex differences were associated with any of the measures. Reading level was found to have a slight effect on search and inquiry time. No relationship was found between a school-administered group intelligence test score and search and time. The evidence taken together points to the independence of the inquiry measures from background factors. The relationship of inquiry to grade in school is more complicated. In general, the inquiry score means increased with grade level. The scores for third grade, though, were significantly out of sequence and this fact is regarded as additional evidence for the relative independence of the inquiry process from background factors. The implication is that developmental and nondevelopmental factors were operating at the same time. It was hypothesized that either might have a demonstrable effect on inquiry behavior; it was not anticipated that evidence for both would be obtained. In retrospect, the results make sense. As a child gets older, he becomes more experienced, if not more capable, in understanding the highly conceptual role as is required by the Mayor task; yet probably no one can ask more questions than a young child when confronting, for example, a carpenter or a plumber--if given free reign. To have more than tentative evidence for the interrelationship, it will be necessary to work with subjects over a wider range of age and to make specific hypotheses on the basis of related factors. Following Shulman's results, personality factors should be related and, also, classroom group characteristics should be relevant. A reasonable conclusion for now is that, given the limits of this elementary school sample, inquiry activity is relatively independent of sex differences, reading level and intelligence, and that it can be relatively independent of grade level. It is also concluded, though, that grade level has a general overall positive relationship with inquiry scores, i.e., the children in the higher grade levels generally obtain higher inquiry scores.

Almost no evidence was found for any relationship between creativity scores and inquiry scores. The few significant correlations do not argue against the independence of the scores. The sample of creativity tests

(Chapter 5) is small, but at the outset of the study there was good theoretical reason to think that there would be evidence for some relationship. Recent data (Karlins, 1967) are consistent with our findings and speculation about the meaning of no relationship between creativity and inquiry scores is in order. It had seemed that these two processes ought to be related, certainly more than inquiry would be related to intelligence measures. Given the present-day conceptualization of intellectual functioning, it is necessary to choose between one side of analogous dichotomies or the other. Wallach and Kogan's (1965) argument that we need to consider as modes of cognitive functioning both a child's creativity and intelligence is compelling. The power of Cattell's concepts, "fluid" and "crystallized" intelligence and his findings as summarized in a recent report (1968) seem to be definitive. Given the choice, it seemed that inquiry activity as a mode of cognitive functioning would have to be related with the creativity test scores. It has already been pointed out that the inquiry scores do not correlate with the measure of intelligence used. Karlins reports no correlation of measures of information processing and measures of creativity; our findings support his. The implication, offered tentatively, is that inquiry behavior is a third mode of intellectual functioning. No conclusions are possible without continued investigation of the problem. Such investigations would necessarily have to make systematic predictions about which variables will correlate and which variables will not correlate. The only conclusion for the present study can be that creativity and inquiry measures are uncorrelated.

We turn now to a discussion of the experimental studies (Chapter 5). In the first experiment, a movie, programed instruction, and discussion under two conditions--preference for teaching method and no preference--had no effect on inquiry scores over a week trial. We had anticipated some change; an effect was expected particularly under the condition of student preference for teaching method. The pattern of inquiry resembled that under nonexperimental conditions. It would be tempting to conclude that the teaching methods used individually do not affect inquiry activity. Because of the pilot nature of the experiment, several other experiments need to be made before such a conclusion could be reached. For instance, it is necessary to know simply whether more teaching would have a net effective result. (Three days were used in Experiment

II, whereas there were only two in Experiment I.) It is also necessary to know whether children who had some previous experience as Mayor would have been fundamentally more effected. (The children in Experiment II had participated in one session prior to the experiment.) The main implication that can be drawn is in comparison with Experiment II. Teaching methods which show no effect when used individually may have a potential effect if used in conjunction with each other and under radically different conditions. The flaw in the argument is that additional materials (about one-quarter more) were used, and it is not possible to know whether these materials were critical for the difference. A reasonable conclusion for the present study is that specific teaching methods--a movie, programed instruction, and discussion--used for two days between three inquiry sessions in a one week trial--have no effect on inquiry activity.

The most important finding was that a learning center designed to teach inquiry significantly increased inquiry activity. It is first of all important to recognize that inquiry activity can be increased. Suchman (1962) has shown that the number of questions children ask can be increased. It has been possible for us to demonstrate that not only can the number of questions be increased but also the number of problems sensed and the amount of information used before reaching a decision. Second, as hypothesized, it was possible to elevate inquiry activity using a teaching environment. The implication is that the learning center is potentially an important tool for the teaching of inquiry. It provides the teacher with the possibility of only planning the student's environment and thereby reducing the conflict that normally exists between directive teaching and student inquiry. Critical questions need to be explored. For instance, is an environment only useful for teaching inquiry skills or can specific subjects be taught? Once inquiry activity has been increased, does it stay elevated? The way in which future investigations can best handle these questions and many others which might be raised is to move the focus of the research to a realistic school setting. In such a setting, it would be possible to measure inquiry activity on a long term basis and also over a variety of subject matters. Given the limits of the sample, the conclusion is that an environment designed to teach inquiry--used for three days between four inquiry sessions in a seven day trial--significantly increases inquiry activity.

The original hypothesis with regard to the effect of structure on the teaching environment was not confirmed. The increase in inquiry activity for the open learning center and the structured learning center was comparable. The finding was interpreted as evidence that the comparison involved degrees of structure that were not sufficiently different to yield differential results. The interpretation is, of course, only an educated conjecture. The environments were the same except for teacher direction--but the materials were for the most part designed for independent learning. Future investigations will need to systematically test wide variations in structure. A post hoc hypothesis was made stating that there need not have been a difference between the effects of the two environments if one wants to test the importance of teacher direction. The implication is that since inquiry activity increased under both conditions, teacher direction is unnecessary in the learning center. There is a need to test a full range of possibilities with regard to structure and teacher direction, but it stands as an important finding that the teacher was unnecessary except to organize the environment and lead discussions when asked.

In conclusion, we have found that children will engage in inquiry activity when given the opportunity and that they can be meaningfully differentiated on the basis of the time they spend inquiring. Children who spend more time, see more problems, ask more questions, and use more information. Inquiry scores are highly interrelated; they are relatively uncorrelated with other variables, although they tend to increase with grade level. Finally, a teaching environment can effectively increase inquiry activity--comparably, under teacher direction or student direction.

REFERENCES

Allender, Donna, S. and Allender, J.S. I Am the Mayor. Diazoed, Miami University, Oxford, Ohio, 1965.

Allender, J.S. The programming of instructional materials for medical education. Journal of Medical Education, 1964, 39, 346-354.

Allender, J.S. The importance of recorded communication. AV Communication Review, 1967, 15, 412-422. (a)

Allender, J.S. A theory for the teaching of inquiry. Paper read at American Psychological Association meeting, Washington, D.C., September, 1967. (b)

Allender, J.S., Bernstein, L.M., and Miller, G.E. Differential achievement and differential cost in programmed instruction and conventional instruction in internal medicine. Journal of Medical Education, 1965, 40, 825-831.

Ausubel, D.P. Some psychological and educational limitations of learning by discovery. The Arithmetic Teacher, 1964, 11, 290-302.

Beach, L.R. Use of instructorless small groups in a social psychology course. Psychological Reports, 1962, 10, 209-210.

Berlyne, D.E. and Frommer, Frances D. Some determinants of the incidence and content of children's questions. Child Development, 1966, 37, 177-189.

Bloom, B.S. (Ed.) Taxonomy of educational objectives: Handbook I: Cognitive domain. New York: David McKay, 1956.

Bowers, N.D. Psychological forces influencing curriculum decisions. Review of Educational Research, 1963, 33, 268-277.

Bruner, J.S. The act of discovery. Harvard Educational Review, 1961, 31, 21-32.

Bruner, J.S., Goodnow, Jacqueline J., and Austin, G.A. A study of thinking. New York: John Wiley, 1956.

Cattell, R.B. Are I.Q. tests intelligent? *Psychology Today*, 1968, 1 (10), 56-62.

Covington, M.V., Crutchfield, R.S. and Davies, Lillian B. *The productive thinking program: Series one: General problem solving*. Berkeley: Educational Innovation, 1966.

Cremin, L.A. *The transformation of the school*. New York: Random House, 1961.

Dixon, W.J. and Massey, F.J. *Introduction to statistical analysis*. (2nd ed.) New York: McGraw-Hill, 1957.

Furst, E.J. *Constructing evaluation instruments*. New York: David McKay, 1958.

Greene, E.B. Relative effectiveness of lecture and individual reading as methods of college teaching. *Genetic Psychological Monographs*, 1928, 4, 457-563.

Gulo, E.V. and Nigro, M.R. Classroom learning as a function of method of presenting instructional materials. *Psychological Reports*, 1966, 19, 971-977.

Hemphill, J.K., Griffiths, D.E., and Frederiksen, N. *Administrative performance and personality*. New York: Bureau of Publications, Teachers College, Columbia University, 1962.

Jarolimek, J. The taxonomy: Guide to differentiated instruction. *Social Education*, 1962, 26, 445-447.

Kagan, J. Reflection-impulsivity: The generality and dynamics of conceptual tempo. *Journal of Abnormal Psychology*, 1966, 71, 17-24.

Karlins, M. Conceptual complexity and remote-associative proficiency as creativity variables in a complex problem-solving task. *Journal of Personality and Social Psychology*, 1967, 6, 264-278.

Ketcham, C.H. and Heath, R.W. The effectiveness of an educational film without direct visual presentation of content. *AV Communication Review*, 1963, 11, 114-123.

McGuire, Christine. A process approach to the construction and analysis of medical examinations. *Journal of Medical Education*, 1963, 38, 556-563.

McGuire, Christine H. and Babbott, D. Simulation technique in the measurement of problem-solving skills. Journal of Educational Measurement, 1967, 4, 1-10.

Metcalf, L.E. Research on teaching the social studies. In N.L. Gage (Ed.), Handbook of research on teaching. Chicago: Rand McNally, 1963. Pp. 929-965.

Miller, G.A., Galanter, E., and Pribram, K.H. Plans and the structure of behavior. New York: Henry Holt, 1960.

Podell, Harriet A. and Carter, H.D. Effects of cognitive set and the variety of relevant experience on concept formation in children. USOE Cooperative Research Project No. 1459, University of California, Berkeley, 1963.

Rimoldi, H.J.A. and Devane, J.R. Training in problem solving. USOE Cooperative Research Project No. 1015, Loyola University, Chicago, 1961.

Rimoldi, H.J.A., Fogliatto, Hermelinda M., Haley, J.V., Reyes, Isabel O., Erdmann, J.B. and Zacharia, Rose M. Training in problem solving. USOE Cooperative Research Project No. 1449, Loyola University, Chicago, 1962.

Rokeach, M. The open and closed mind. New York: Basic Books, 1960.

Scheerer, M. Problem-solving. Scientific American 1963, 208 (4), 118-128.

Schwab, J.J. The teaching of science as enquiry. In J.J. Schwab and P.F. Brandwein, The teaching of science. Cambridge, Mass.: Harvard University Press, 1962.

Shaver, J.P. Educational research and instruction for critical thinking. Social Education, 1962, 26, 13-16.

Shulman, L.S. Seeking styles and individual differences in patterns of inquiry. Unpublished doctoral dissertation, University of Chicago, 1963.

Shulman, L.S. Seeking styles and individual differences in patterns of inquiry. School Review, 1965, 73, 258-266.

Snedecor, G.W. Statistical methods: Applied to experiments in agriculture and biology. (5th ed.) Ames, Iowa: Iowa State University Press, 1956.

Suchman, J.R. Inquiry training: Building skills for autonomous discovery. Merrill-Palmer Quarterly, 1961, 7, 147-169.

Suchman, J.R. The elementary school training program in scientific inquiry. USOE Title VII Project No. 216, University of Illinois, Urbana, 1962.

Torrance, E.P. Guiding creative talent. Englewood Cliffs, N.J.: Prentice-Hall, 1962.

Wallach, M.A. and Kogan, N. A new look at the creativity-intelligence distinction. Journal of Personality, 1965, 33, 348-369.

Wallen, N.E. and Travers, R.M.W. Analysis and investigation of teaching methods. In N.L. Gage (Ed.), Handbook of research on teaching. Chicago: Rand McNally, 1963. Pp. 448-505.

Williamson, J.W. Assessing clinical judgment. Journal of Medical Education, 1965, 40, 180-187.

APPENDICES A-F

APPENDIX A

INDIVIDUAL INSTRUCTIONS FOR PLAYING THE MAYOR

Parts of these materials
have been reprinted
from I Am the Mayor

by and by permission
of Donna S. Allender
and Jerome S. Allender

Copyrighted 1965

Permission to reproduce this copyrighted material has been granted by Donna S. Allender and Jerome S. Allender to the Educational Research Information Center (ERIC) and to the organization operating under contract with the Office of Education to reproduce ERIC documents by means of microfiche or facsimile hard copy, but this right is not conferred to any user of ERIC materials. Reproduction by users of any copyrighted material contained in documents disseminated through the ERIC system requires permission of the copyright owner.

Have you ever thought about what a mayor of a city does? The work you are about to do was written with the idea that it will allow you to act like a mayor of a small city. The materials you will use are called I Am the Mayor. They were written to teach you something about city government, but they were also written to do something more. They allow you to do the work a mayor really does. To use these materials, you pretend you are a mayor.

As mayor, you will get letters, notes, messages about phone calls, and reports which you will have to read. This is your work. It will be about water problems, city growth, road problems, school safety, reports from committees and other city problems. Your job will be to look up things in your files so that you will know what you want to do about each letter, note, message, and report. Your files have many useful things in them. There are calendars, laws, maps, information reports, information on city growth, committee reports, city budgets, and letters of all kinds. After finding out all that you want from the files, you can decide what to do. You may decide not to do anything right now--you may want to throw the letter in the waste basket. You may decide to do something like tell your secretary to make a telephone call, or write a note or letter to someone.

Imagine yourself as a mayor. You are in your office and your secretary has given you your work. (See Example 1.) Notice that there are numbers down the right side of your letter. You have a very modern office and most of the work is done with numbers. While you are reading, you should try to think of questions that need to be answered before you decide what to do about this letter. Every time you think of a question, find the number closest to the part of the letter where you thought of the question.

Let's say that you think of questions near 321, 322, and 323. There is a page of questions for each number. (See Examples 2, 3 and 4.) You can choose to ask as many of the questions as you like on each page. Your secretary has tried to think of everything you might want to look up in your files. Choose the questions that are the most like the ones you think of. Every time you choose a question, go to the number of the page of the file that comes after the question.

You can look at as many pages of your files as you want. This is what you would find if you asked all of the questions on page 322. (See Examples 5, 6, 7, 8, 9 and 10.)

When you have finished looking at all the files you want to see, you should decide what to do. Let's say you now want to decide about this letter from Mr. Vale. You must go to the page whose number follows the sentence, "I want to make a decision." In this case, you would go to page 812. (See Example 11.) You then choose one kind of decision. On pages 903, 904, and 905 you will find several decisions from which to choose, including one that you can make up. (See Examples 12, 13 and 14.)

On the banks of the Bluewater Creek is a small city called Tinker. You are the mayor of Tinker. You want to help Tinker grow and be a better city in which to live. It is now 9 o'clock Monday morning. The name of your secretary is Jones. Your office has been taken care of by your secretary while you were away for two weeks.

There are no right answers. You are the mayor and whatever you say goes. In fact, one of the things you learned while you were away was that mayors don't use their files enough. You have come back from your trip and have made up your mind to try and see if your files can help you make decisions. Use as many pages of questions as you want and as many pages of the files as you want. Remember, there are no right answers. Do what you want to do because you are the mayor of Tinker.

EXAMPLE 1

112

512 South Sun Street
Tinker, Colorado
April 320

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

The Business Club of Tinker wants the City to
build a new parking lot in downtown Tinker. We 321
feel the City Council should carefully study Tinker's
need for another lot in that part of town. If there 322
were more parking spaces open during the shopping
hours, people from towns around Tinker would be more
interested in coming to Tinker to shop. We would be 323
pleased if you would be in favor of the idea when we
bring it up at a City Council meeting. 324

Yours truly,

Lee Vale
Tinker Business Club 325

I want to make a decision. 812

EXAMPLE 2

From page 112 321

How many parking lots are there in downtown Tinker? I would like to see a map of downtown Tinker.	File 4	Page 363
Where is downtown Tinker? I would like to see a map which shows different areas of Tinker.	File 4	Page 371
What is the Business Club of Tinker? I would like to see a list of committees and groups in Tinker.	File 18	Page 616
My question is not here. I want to see a list of all my files.		Page 300

EXAMPLE 3

From page 112

323

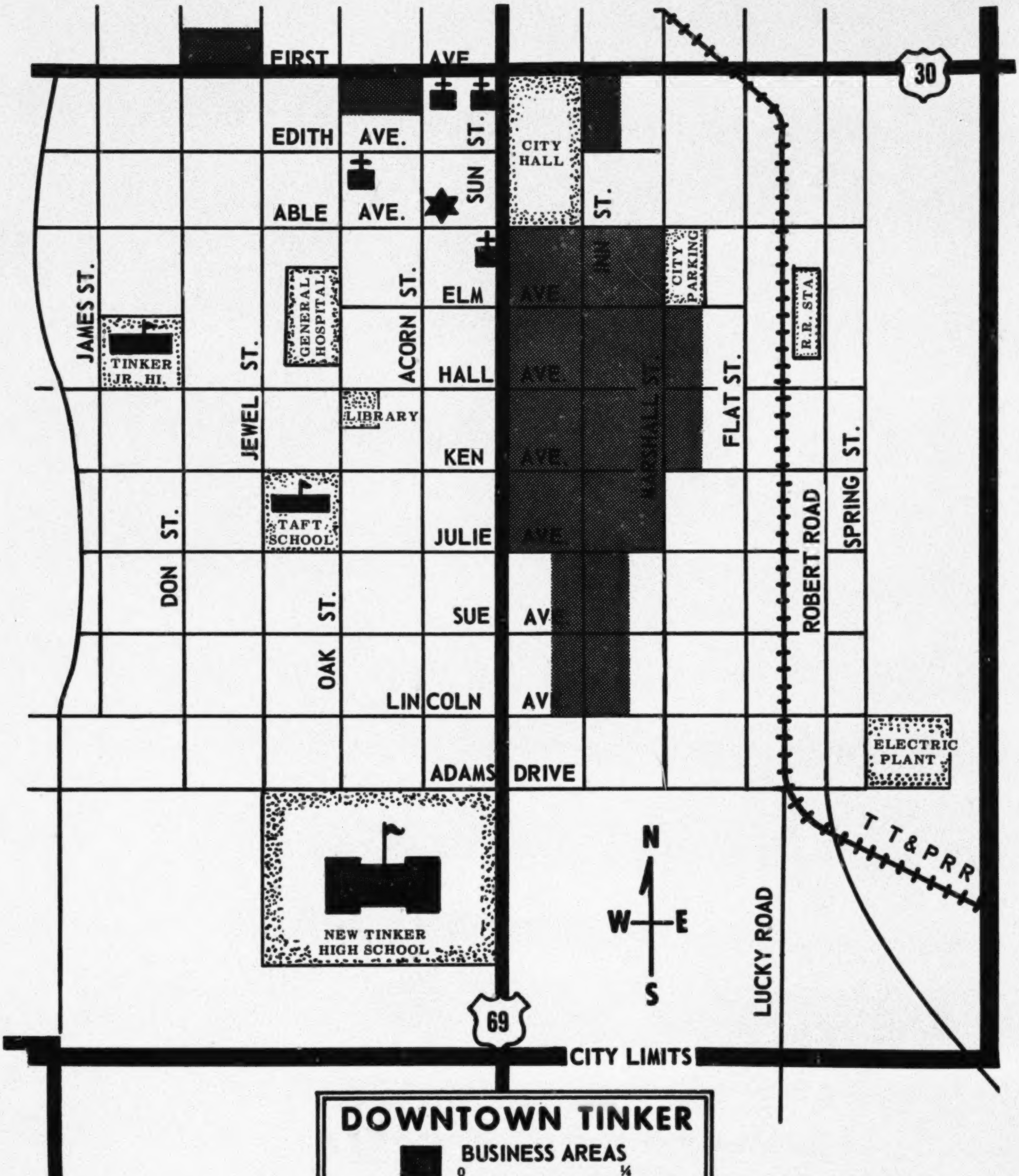
How many towns are there around Tinker? I would like to see the map of Tinker and towns around it.	File 4	Page 362
How many parking spaces are there in downtown Tinker? I would like to see the Traffic and Parking Chart.	File 16	Page 599
What are the shopping hours of the stores in Tinker? I would like to see the Rules for Businesses in Tinker written by the Business Club.	File 18	Page 630
My question is not here. I want to see a list of all my files		Page 300

EXAMPLE 4

From page 112 322

How many parking lots are there in downtown Tinker? I would like to see a map of downtown Tinker.	File 4	Page 363
How many parking spaces are available in downtown Tinker now? I would like to see the Traffic and Parking Chart.	File 16	Page 599
Are there other letters about the need for more parking in Tinker? I would like to see the Mayor's letters about parking.	File 20	Page 785
My question is not here. I want to see a list of all my files.		Page 300

EXAMPLE 5


FIRST AVE
EDITH AVE.
ABLE AVE.
ELM AVE.
HALL AVE.
KEN AVE.
JULIE AVE.
SUE AVE.
LINCOLN AVE.
ADAMS DRIVE
JAMES ST.
JEWEL ST.
DON ST.
OAK ST.
ACORN ST.
SUN ST.
INN ST.
MARSHALL ST.
FLAT ST.
ROBERT ROAD
SPRING ST.
LUCKY ROAD
CITY HALL
CITY PARKING
R.R. STA.
ELECTRIC PLANT
GENERAL HOSPITAL
TINKER JR. HI.
LIBRARY
TAFT SCHOOL
NEW TINKER HIGH SCHOOL
30
69
T T&P R R
N
W
E
S
CITY LIMITS
DOWNTOWN TINKER
BUSINESS AREAS
0
¼
MILES

EXAMPLE 6

CITY GROWTH CHART:

Traffic and Parking

	1950	1960	Last Year
Cars in Tinker	2,000 Cars	2,500 Cars	3,000 Cars
Parking Downtown	300 Spaces Downtown	500 Spaces Downtown	500 Spaces Downtown
Stop Lights	6 Stop Lights	10 Stop Lights	10 Stop Lights
Time to Drive Through Downtown Tinker	3 Minutes	6 Minutes	10 Minutes

EXAMPLE 7

LETTERS ABOUT TRAFFIC AND PARKING

From Mr. Orth . . . . Page 786

From Mrs. Brewer. . . . . Page 787

EXAMPLE 8

786

971 Wilson Drive
Robert Town, Colorado
March

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

My wife and I enjoy coming to Tinker to shop. At least we used to enjoy it. In the last few months we have found we cannot find a parking place even in the city parking lot. We have not been coming to Tinker as often because of the parking problem.

We thought you might be interested in knowing our feelings. Perhaps many other people feel as we do. Isn't there something the city of Tinker could do to make sure there is more parking for shoppers.

Yours truly,

Mr. Tim Orth

EXAMPLE 9

787

107 Washington Lane
Tinker, Colorado
February 3

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

There has been a lot of talk in the Southside areas about Tinker's need for another parking lot. I fully agree that Tinker needs more parking space in the downtown area. However, is it really the job of the City to build it? Shouldn't a private company build a lot if there is really a need for one? I think the city should invite a company which builds and runs parking lots in other cities to come and see if Tinker wouldn't be a good place to build one.

Yours truly,

Mrs. Ralph Brewer

EXAMPLE 10

300

INDEX OF FILES

General Information		Page 301
File 1	Calendars	Page 310
File 2	History	Page 335
File 3	Laws	Page 340
File 4	Maps	Page 360
File 5	Information Bulletins	Page 375
Departments		Page 302
File 6	Electric	Page 405
File 7	Fire	Page 415
File 8	Garbage and Sanitation	Page 425
File 9	Park	Page 435
File 10	Police	Page 450
File 11	Street	Page 490
File 12	Water	Page 505
Current Business		Page 303
File 13	City Budgets and Money	Page 520
File 14	City Committees	Page 540
File 15	City Council	Page 575
File 16	City Growth Charts	Page 590
File 17	City Plan	Page 605
File 18	Clubs and Committees in Tinker	Page 615
Letters		Page 304
File 19	Mayor's Letters	Page 665
File 20	City Letters	Page 730

EXAMPLE 11

From page 100 812

I don't want to do anything about
this message right now. 903

I need to find out something that
is not in my files. 904

I would like to do something about
this right away. 905

EXAMPLE 12

From page 812

903

A. Do what you think best with this.

B. Put this where it belongs in my files.

C. Put this with work to be done later today.

D. I want to keep this on my desk for a while.

E. I want to put it somewhere else.

Tell your secretary what you have decided.
Be sure to tell the letter of the one you choose.

When you have decided what to do, there is more work on page 100.

EXAMPLE 13

From page 812

A. Ask the Business Club to find out how many parking spaces a city the size of Tinker should have.

B. Call the Police Department and ask for all information they have about parking problems in Tinker.

C. Find out what it costs to build parking lots.

D. I need to know something else.

Tell your secretary what you have decided. Be sure to tell the letter of the one you choose.

When you have decided what to do, there is more work on page 100.

EXAMPLE 14

From page 812 905

A. Write Mr. Vale that his group should do what is best for the city.

B. Write Mr. Vale and ask him to find someone to do a study of how many more people could come to Tinker to shop.

C. Write Mr. Vale that I will be in favor of the City biilding a new parking lot when it is brought up at the Council meeting.

D. I want to do something else.

Tell your secretary what you have decided. Be sure to tell the letter of the one you choose.

When you have decided what to do, there is more work on page 100.

APPENDIX B

TECHNICAL MANUAL FOR
THE INQUIRY RECORDER

written with the
assistance of
Edward S. Jurowski
and
illustrated by
Robert Karol

An overview of the system is shown in Diagram 1. A standard microfilm reader with a movable table was modified to receive aperture cards. The inquiry materials were reproduced on aperture cards and the page numbers were punched into the cards using a binary code. The code uses four rows of four open-close positions and is capable of storing one four digit decimal number. This code is used to operate light sensitive diodes located in the card reader table under the aperture cards; they send a signal to the printer control (See Diagrams 2 & 3). A further modification was made in the original equipment to regulate the viewing of the film in the microfilm reader. The light for the reader can only be actuated when the subject depresses an external manual press-switch (Diagram 4, S-6). The switch is also used to start a clock in the control center that sends pulses at the rate of one every six seconds to the counter (Diagram 5). By design, if the subject releases the switch before the end of a six second interval, the clock will advance to the next complete tenth of a minute when the card reader table is pulled out.

The function of the control center (Diagram 5) is primarily one of coordinating the various unit functions of the entire assembly. The chasis of the control center contains all the equipment with the exception of the microfilm card reader and the printer (See Diagram 1). The control center is made up of three parts: (1) the counter and the printer control equipment, (2) the front panel and (3) the subchasis containing the actual control and coordinating equipment for the system. On the front panel of the control center are lights that indicate: power-on, table-in, table-out, clock-on. These lights, when used with a check of the tape output of the printer, can enable the experimenter to determine difficulty on the part of the subject or the equipment. The power light is on when switch S-2 is closed to complete the secondary power requirements of the equipment located within the control center chasis.

The movement of the table is used to operate two microswitches (Diagram 6). Microswith MS-3 is a normally open switch mounted on the base of the microfilm reader and is triggered by a cam attached to the table. Each time the table is pushed in, the switch is closed thereby sending a pulse to the printer control and causing it to print the page number of the aperture card and the associated time from the counter. Microswitch MS-4 is a normally closed switch that is opened by another cam on the table when the table is pushed in; thereby de-energizing relay K-1 (Diagram 5).

The table-in and table-out lights are in series with the secondary contacts of relay K-1 which are in parallel with the secondary power supply and are actuated when the relay is energized (table-out) or not energized (table-in). There are also three push button switches on the control center front panel (Diagram 5): S-3 is used to reset the counter at the completion of an experiment, S-4 advances the tape in the printer, and S-5 causes the printer to print out of cycle. Both switches S-4 and S-5 complete the circuit to the printer control which is necessary to carry out the function indicated, while S-3 is connected directly to the counter.

The printer receives a signal from the printer control each time the microfilm reader table is pushed in. These pulses actuate the printer which is an adding machine modified to use solenoids to depress the keys. The pulses to the printer are applied to the solenoids in sequence from left to right; time is printed on the left and the page number is printed on the right.

Special Parts List

Recordak:
Filmcard Reader Model PFC-46-1

United Systems Corporation:
Digitec Automatic Identification Model 652
Digitec Printer System Model 610-620
25 conductor cable with connectors, stock no. 4378-20
Connectors: DA-15S, DA-15P, DB-25P, DB-25S

Allied Electronics Corporation:
Relay (K-1), catalog no. 41Z5197
Motor (clock advance 10 RPM), catalog no. 41Z7151C
Light sensitive diodes, catalog no. 60A75490
Lampholders, catalog no. 60A6623

Parts Generally Available:
MS-1, 3, 5, 6: (SPST normally open)
MS-2, 4: (SPST normally closed)
S-1: (DPST)
S-2: (SPST)
S-3, 4, 5: (pushbutton normally open)
S-6: (part of Recordak viewer)
R-1, 2, 3, 4: (1 megohm, ¼ watt)
C-1: (240 mmf. 680 v)

DIAGRAM 1

MAJOR COMPONENT WIRING SCHEMATIC

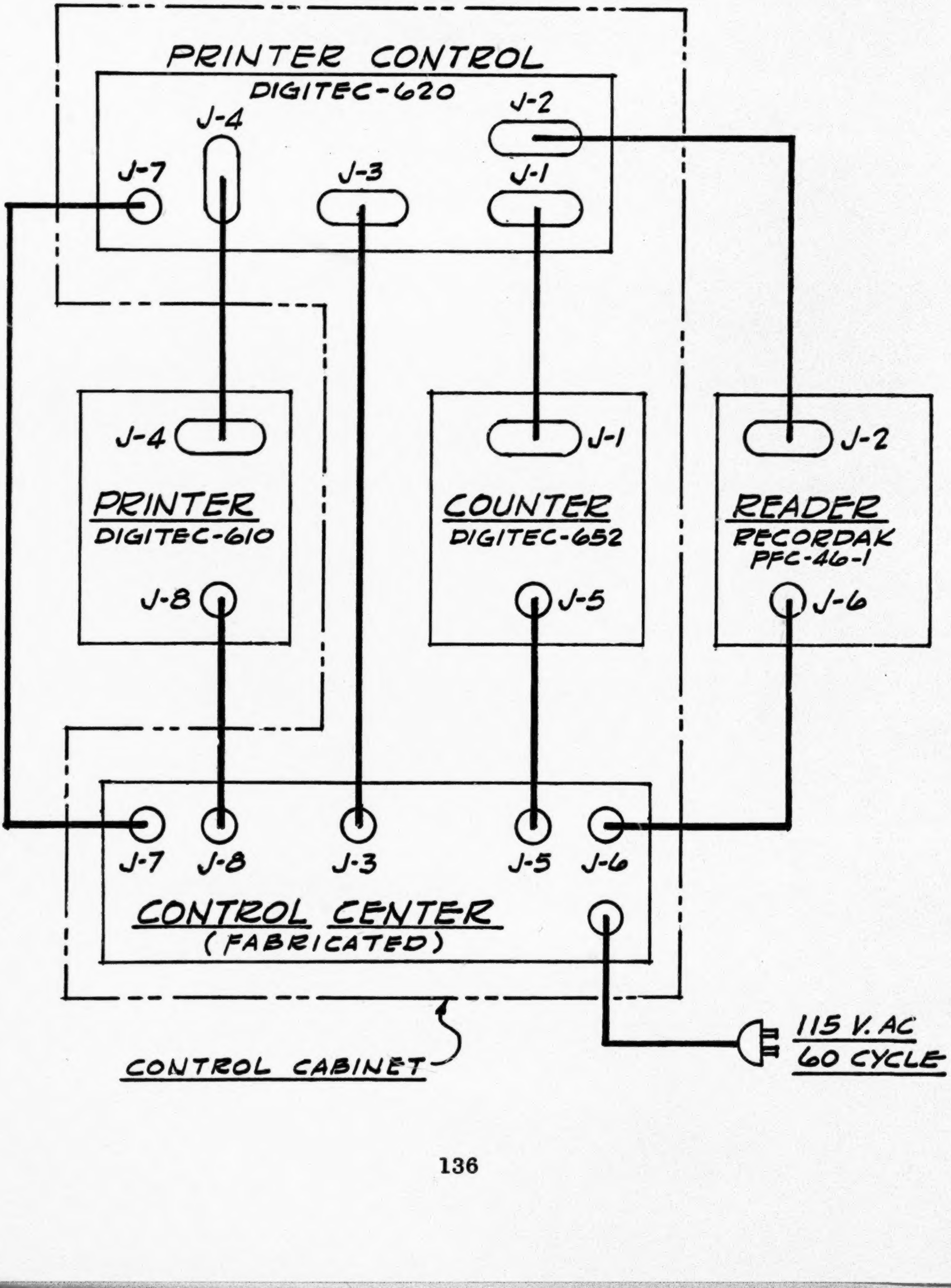

PRINTER CONTROL
DIGITEC-620
J-4
J-2
J-7
J-3
J-1
J-4
PRINTER
DIGITEC-610
J-8
J-1
COUNTER
DIGITEC-652
J-5
J-2
READER
RECORDAK
PFC-46-1
J-6
J-7
J-8
J-3
J-5
J-6
CONTROL CENTER
(FABRICATED)
CONTROL CABINET
115 V. AC
60 CYCLE

DIAGRAM 2

TABLE ASSEMBLY

PLAN VIEW

(NOT TO SCALE)

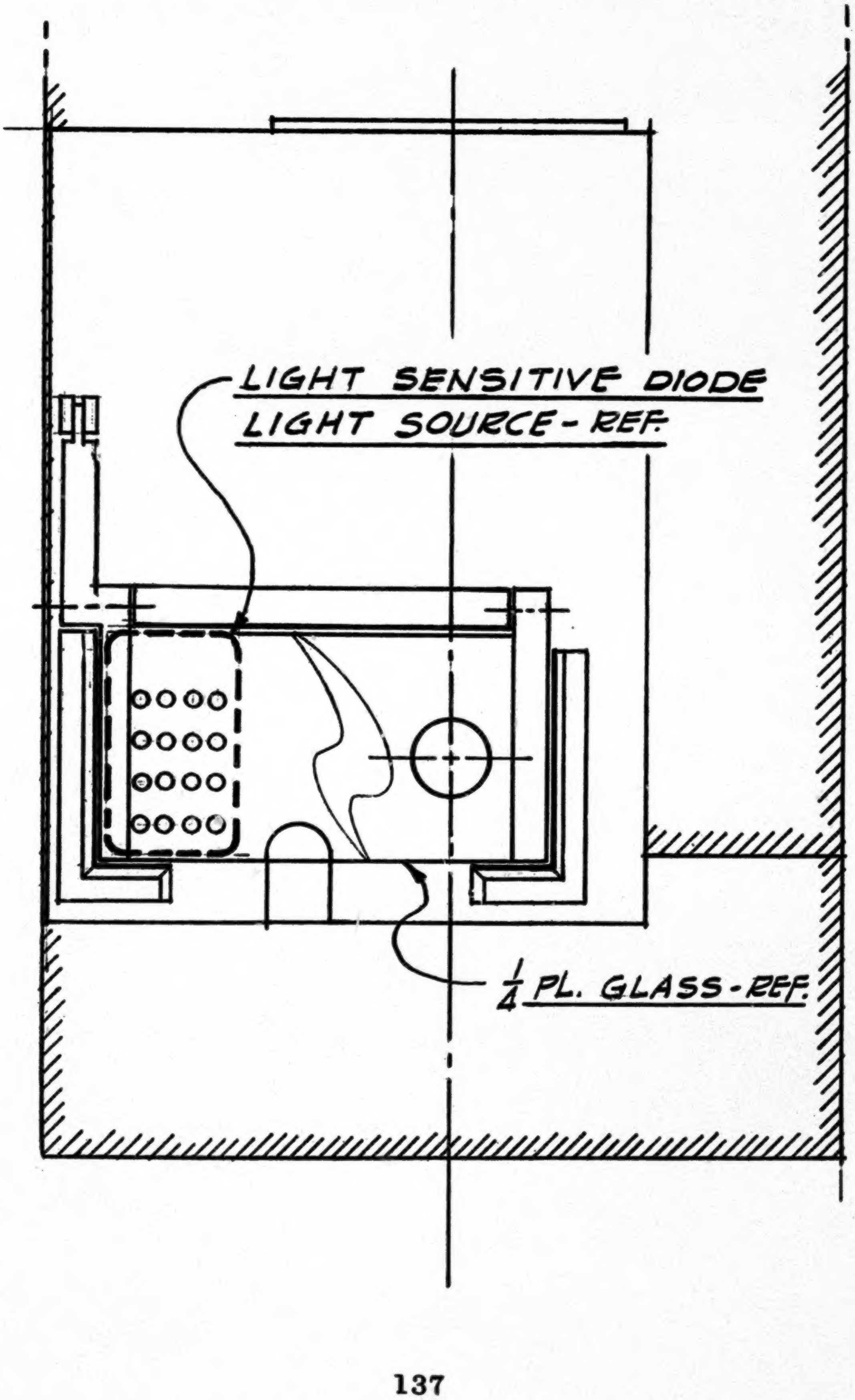

LIGHT SENSITIVE DIODE
LIGHT SOURCE - REF.
1/4 PL. GLASS - REF.

DIAGRAM 3

LIGHT SENSITIVE DIODE WIRING SCHEMATIC

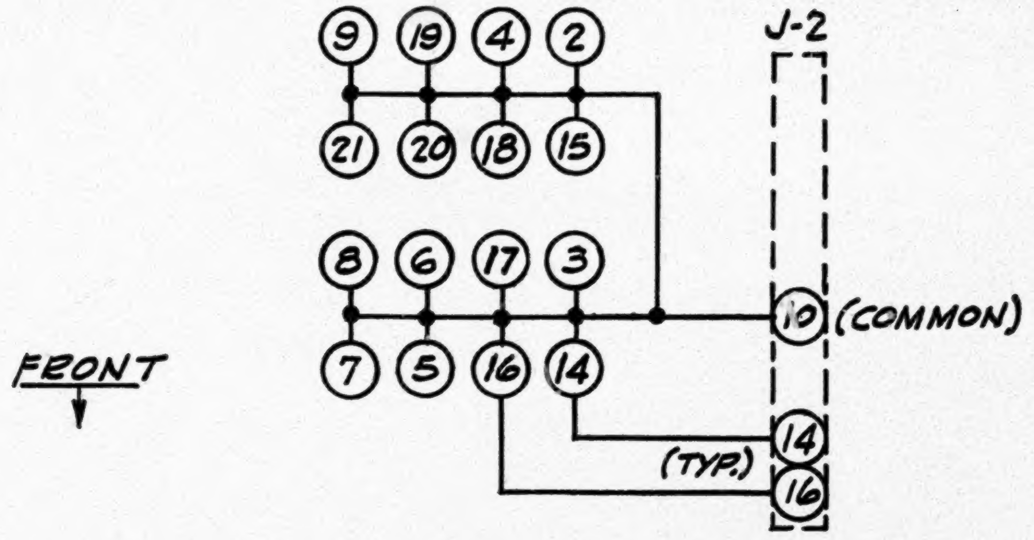

9
19
4
2
21
20
18
15
8
6
17
3
7
5
16
14
J-2
10 (COMMON)
14
(TYP.)
16
FRONT

TABLE DRILLING DIAGRAM – ½ SCALE

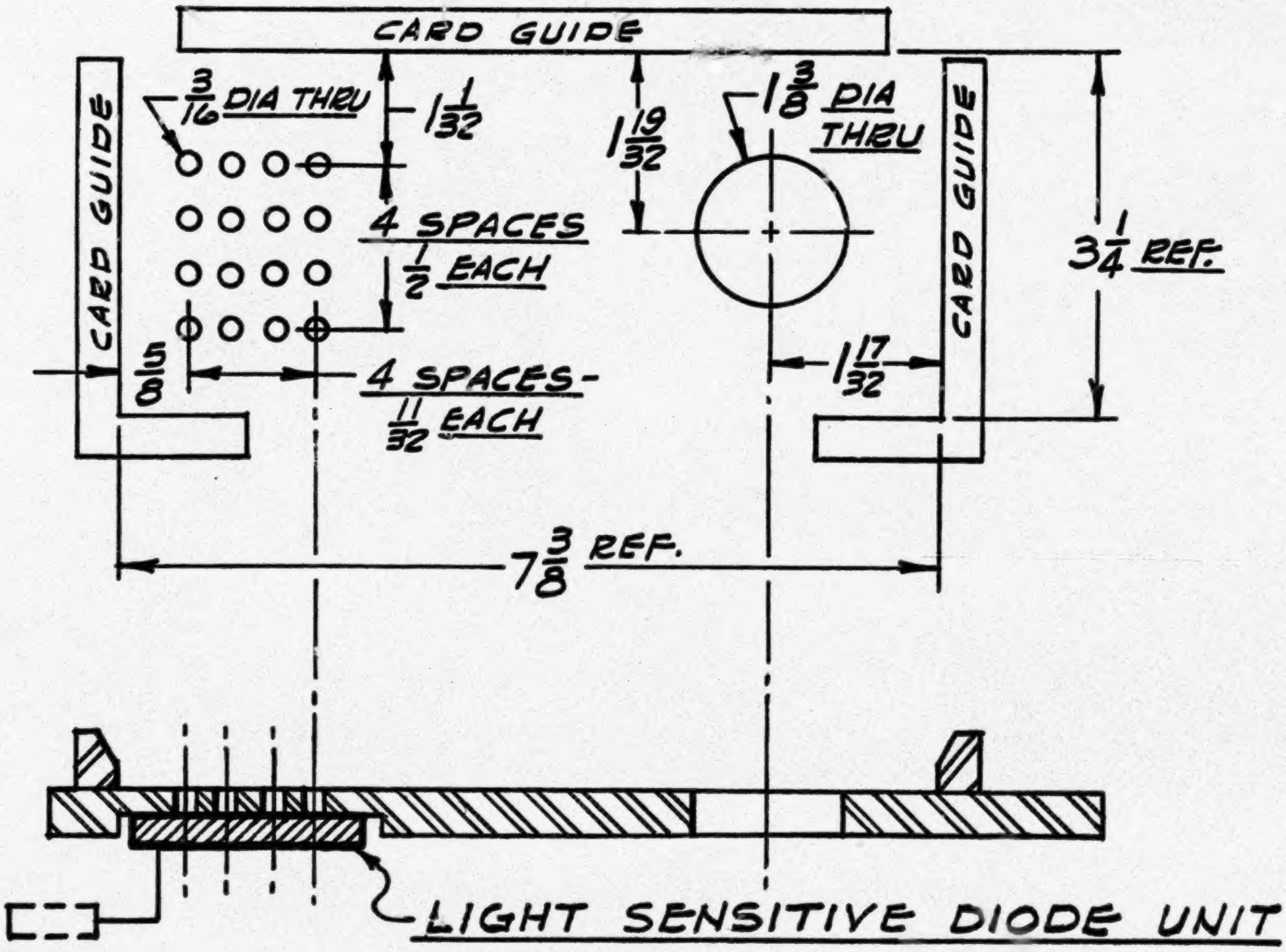

CARD GUIDE
CARD GUIDE
CARD GUIDE
3/16 DIA THRU
1 1/32
1 19/32
1 3/8 DIA THRU
4 SPACES 1/2 EACH
3 1/4 REF.
5/8
4 SPACES- 11/32 EACH
1 17/32
7 3/8 REF.
J-2
LIGHT SENSITIVE DIODE UNIT

DIAGRAM 4

TABLE ASSEMBLY

FRONT VIEW

(NOT TO SCALE)

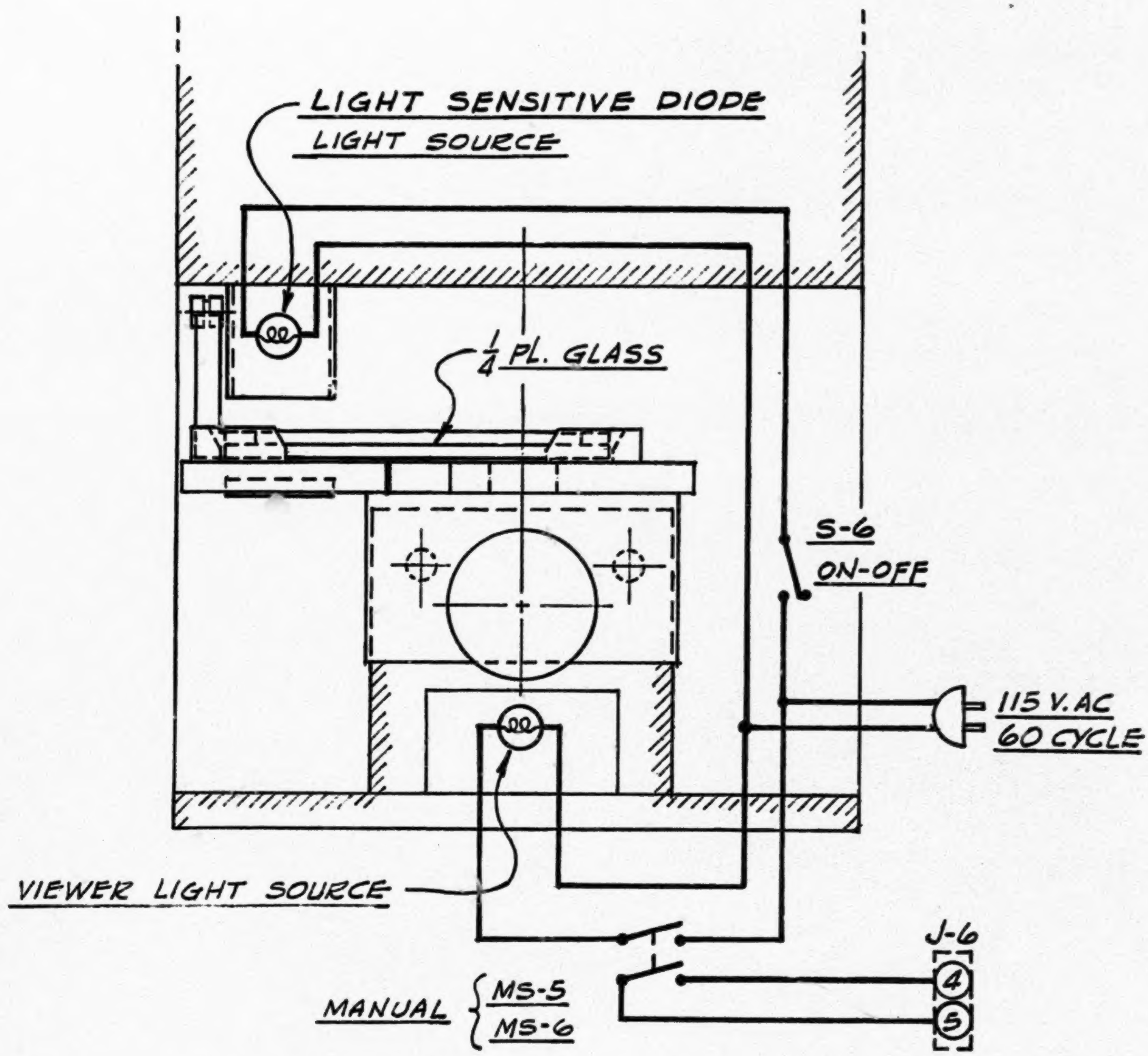
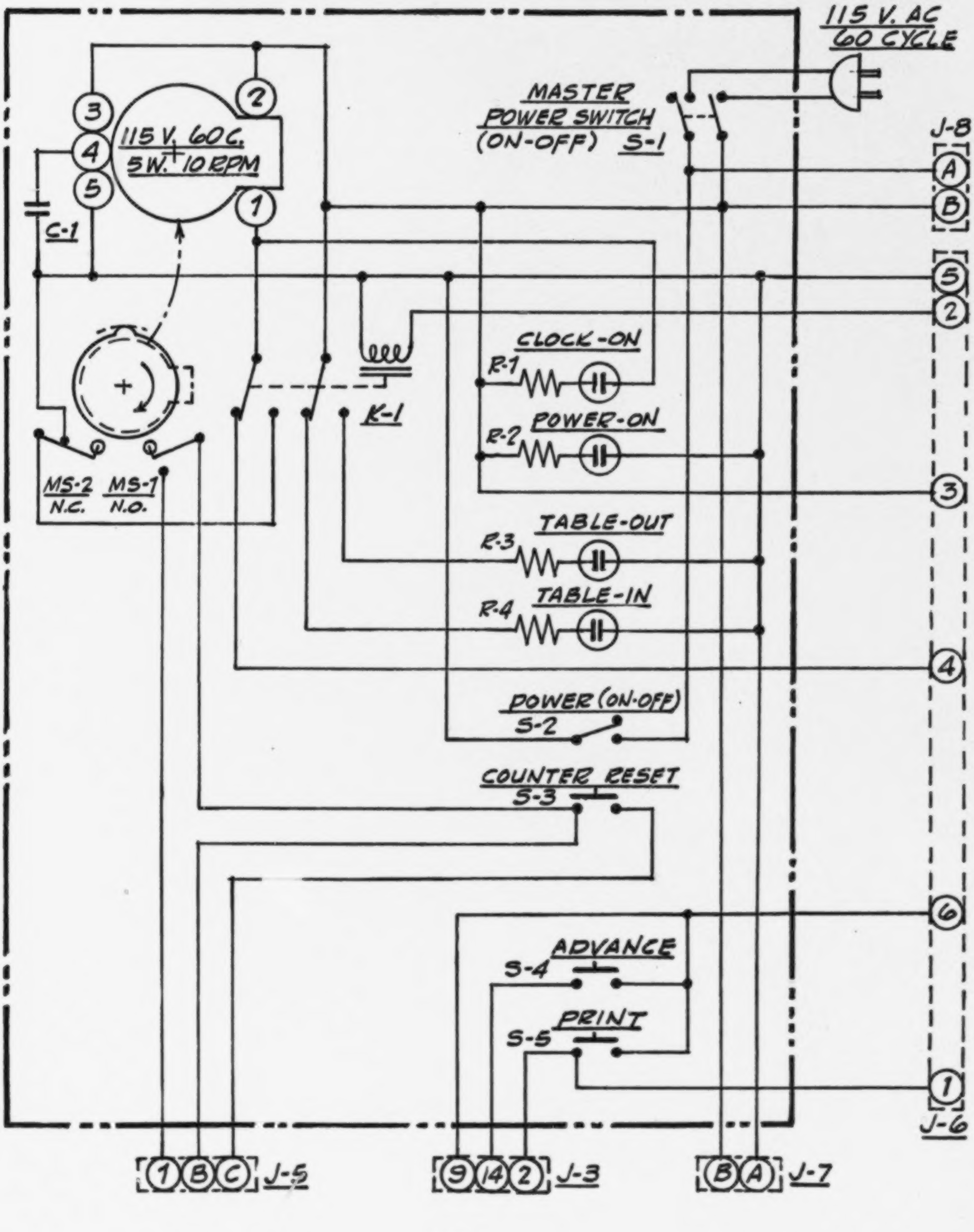

LIGHT SENSITIVE DIODE
LIGHT SOURCE
$\frac{1}{4}$ PL. GLASS
S-6
ON-OFF
115 V. AC
60 CYCLE
VIEWER LIGHT SOURCE
J-6
4
5
MANUAL
MS-5
MS-6

DIAGRAM 5

CONTROL CENTER WIRING SCHEMATIC



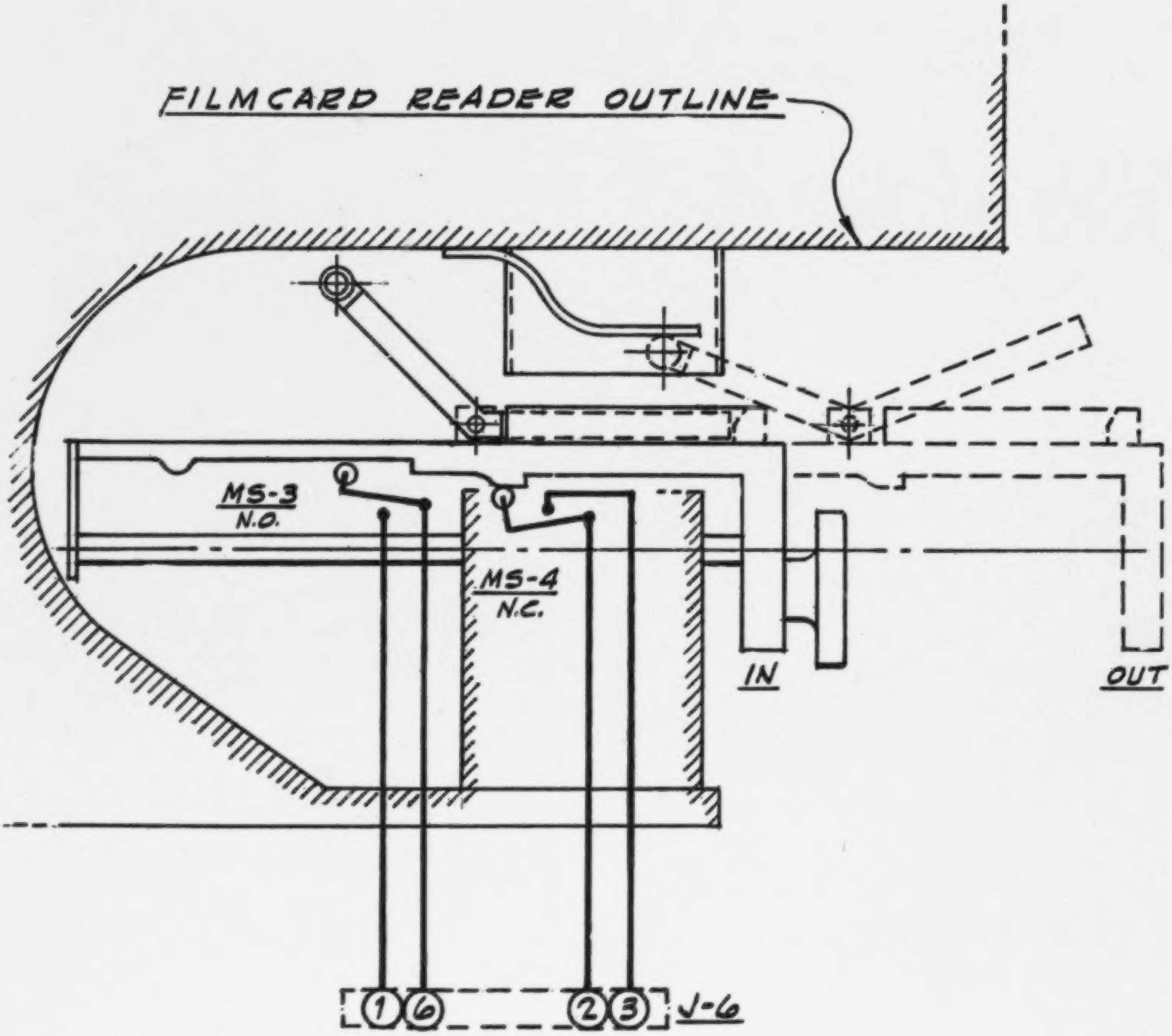
115 V. AC
60 CYCLE
MASTER
POWER SWITCH
(ON-OFF) S-1
J-8
A
B
5
2
3
4
6
1
J-6
3
4
5
2
1
115 V. 60C.
5W. 10 RPM
C-1
K-1
MS-2
N.C.
MS-1
N.O.
CLOCK-ON
R-1
POWER-ON
R-2
TABLE-OUT
R-3
TABLE-IN
R-4
POWER (ON-OFF)
S-2
COUNTER RESET
S-3
ADVANCE
S-4
PRINT
S-5
1
B
C
J-5
9
14
2
J-3
B
A
J-7

DIAGRAM 6

TABLE ASSEMBLY

SIDE VIEW

(NOT TO SCALE)


FILMCARD READER OUTLINE
MS-3
N.O.
MS-4
N.C.
IN
OUT
1
6
2
3
J-6

APPENDIX C

LETTERS USED IN TEACHING MATERIALS

LETTER 1

Dear Mayor,

The swimming pool has been very crowded this summer. There isn't any room for people to swim. There should be a rule about how many people can use the pool at one time.

Yours truly,

Susan Young

LETTER 2

Dear Mayor,

The city buses do not pass our bus stop often enough. When a bus does come by, it is so full of people that it is not pleasant to ride on the bus. We think the city should buy more buses.

Yours truly,

Mr. and Mrs. Alfred Zwenk

LETTER 3

Dear Mayor,

Last year the city improved its garbage collection plan and we thought that was very good. But still we are not satisfied. The amount of garbage we collect each week is more than one garbage can will hold. We think the city should collect garbage two times every week.

Yours truly,

Jim Stone

LETTER 4

TO: The Mayor
FROM: Marvin Papajohn, Tax Department

We have figured out the amount of money the city should collect from taxes for the next two years. The exact amounts are listed in the tax report which is filed in the tax office. Though our tax rate will stay the same, we will have more money for the next two years than we had for the last two years. Of course the need for city services will also be greater.

Copies of the report will be sent to you and other Council members two weeks before the first budget meeting. If there are any questions, please call me.

LETTER 5

Dear Teacher,

My son, Billy, took 30¢ to school yesterday for his lunch. But after gym class he said it wasn't in his pocket. Please see if you can do something about the stealing during gym class.

Sincerely,

Billy's Mother

LETTER 6

Dear Mayor Jackson:

A group of us citizens of your city got together and discussed the possibility of getting rid of all the cars in town and bringing back the horse and buggy. We feel that everyone in town should dress like our forefathers did in the old West. The west is dying out with all these modern gadgets and we'd like our town to be preserved, you know, stay the same as in the old times so that our children will not forget what life used to be like in the west.

We would like you to consider our idea because we feel that a lot of money could be made in our city if such a plan were to be accepted.

We would like to come to the city council meeting and present our plan. Let us know when the Council meets and we shall be there.

Yours truly,

Calvin Smith
Bar XY 876 Ranch
Longhorn, Texas

LETTER 7

TO: Mayor E. J. Patterson

FROM: Citizens of Whitewash

We, the people of Whitewash, Maine and towns around, have gotten together to discuss the need for a landing field for the unidentified flying objects which have been seen landing in this area within the past few months. We propose that a specified area of land be cleared and a reception building be built so that these visitors from other planets will have a suitable place to land their space ships and also to be given a hearty welcome to our country. We hope you will be available to discuss this in further detail. The undersigned are names of just a few of the folks in Whitewash that are interested in seeing this landing field built.

LETTER 8

FROM: Reb Jackson

TO: Mayors

Thank you for discussing the letter I received from the people of Longhorn. I've decided the problem is whether or not I should support these people. What are some of the things I should find out about before I decide?

LETTER 9

FROM: Patterson, Whitewash, Maine

TO: The Mayors

Thank you for your discussion about the letter on unidentified flying objects. I think the problem is to know what these people are really talking about. What things should I find out about before I get together with these people to discuss this.

APPENDIX D

THE MAYOR'S WORK

These materials have
been reprinted from
I Am the Mayor

by and by permission
of Donna S. Allender
and Jerome S. Allender

Copyrighted 1965

Permission to reproduce this copyrighted material has been granted by Donna S. Allender and Jerome S. Allender to the Educational Research Information Center (ERIC) and to the organization operating under contract with the Office of Education to reproduce ERIC documents by means of microfiche or facsimile hard copy, but this right is not conferred to any user of ERIC materials. Reproduction by users of any copyrighted material contained in documents disseminated through the ERIC system requires permission of the copyright owner.

100

PHONE MESSAGE

to: The Mayor

from: Mr. Joe Green

date: April 18 **time:** 3:30 P.m.

person taking message: D. Jones 200

message:

Mr. Green asked if you have made up your
mind about who will be chairman of the group
which will collect the money for the Boy Scouts and
Girl Scouts for the year. He wants to send 201
posters to be printed by Monday, April
28, and he must have the name of the person. 202
The Scouts did not have enough money last
year, so it is important for this group to
get to work soon. Please let him know as 203
soon as you return from your trip. 204

Also, Mr. Green said he would like to
meet with you to make plans for the new Scout
groups for next year. He asked if you would 205
please call a meeting of the Scout Planning
Committee, and he said he is free Wednesday
afternoon, April 30. 206

I want to make a decision. 800

101

TINKER SCHOOLS
TINKER, COLORADO

April 25 210

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

The P. T. A. of the Tinker Schools would like to have a
safety program for the city. We feel this is important for our 211
children. We thought that you, as Mayor, would be one of the
best people in the city to help plan this program. 212

We would like to have something in the program about
safety in crossing streets. You remember that Jeff Stone 213
was hit by a car two weeks ago. It was lucky that he was 214
not hurt badly. We would like this program to help prevent 215
such accidents. There are many other safety problems about
which children and adults need to know and we would like your
ideas about which problems are most important in Tinker. 216

We would like to have this in May. Could you suggest
a good week for this program? We hope you will agree to 217
help with the planning of this safety program for the city. 218

Thank you,
Tinker Schools P.T.A.
Tinker Schools P. T. A. 219

I want to make a decision. 801

102

THE TINKER TIMES

Vol. 10 No. 4 Tinker, Colorado Monday, April 28

MAYOR RETURNS FROM TRIP

The Mayor went to Chicago to a meeting of mayors from many cities and towns in the country. The trip was very interesting and the Mayor enjoyed it very much. The Mayor said, "It was so good to meet and talk to the other men and women who are mayors of other cities. We were able to talk about some problems all our cities have and to get helpful ideas from each other."

220 We are glad the Mayor had a nice trip. We welcome you home and are sure you have learned many new ideas to help Tinker grow and improve.

NEW TAX PLAN

221 The state has started a new plan to give money to small towns to help them grow. The money is to be used by the town for some important building or a road. The town must give half the money needed to do the work.

222 Baby News. . . .Tim & Sue Stevens were born last Saturday to Mr. and Mrs. Paul Stevens from Bander Hill. . . .HAPPY BIRTHDAY TO YOU!

223 Lost. . . .A brown dog named Snow. He is a family pet. He is very large and very friendly. Please call Betty at GR4–5132.

NEW TREES FOR TINKER

The City Flower Club has plans to plant about 100 new trees along streets of Tinker. The club plans to plant elms and oaks because they are good shade trees. 224

DOGS AND CANS

Several people have said that dogs have knocked over their garbage cans in the middle of the night. They make both a mess and a lot of noise. These people wonder if there are laws against letting your dog out alone at night. 225

HOT DAYS AHEAD

The Weatherman says that we can plan to get out our summer clothes early this year. The temperature is expected to rise to 90° by next week. Today's high was 72°. 226

I want to see other work. 103

103

431 Lucky Road
Tinker, Colorado
April 24 230

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

The ladies of the City Flower Club would like the permission of the City of Tinker to plant 100 trees along the streets. Our club would buy the trees, but we would 231
like the city to pay for putting the trees in the ground. 232

It has been planned that we would buy fifty elms and fifty oaks and plant them in groups of five or six on a block. We would like them planted along First Avenue 233
and around New Tinker High School. 234

We hope you will allow our club to help make Tinker a more beautiful city. 235

Yours friends,
City Flower Club
City Flower Club 236

I want to make a decision. 803

104

BEAUTY- GLASS CO.
1973 Seventh Ave., New York, New York

April 18 240

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

Mr. Berg and I want to thank you for our visit in
Tinker last week. You were so very kind to have shown us 241
Tinker. We are now better able to plan where our new factory
should be. 242

After talking about the needs of our company, we agree
that the best land for our factory in Tinker is the block
between Sun Street and Acorn Street between Fifth and Sixth. 243
We will need special permission from the City Council to build
the factory there. We would like you to help us get the 244
permission of the City Council. 245

Except for the fact that Tinker has no airport, we were
very pleased with everything we saw. It would be good for both 246
Tinker and the company if we could buy that land and start
building as soon as possible. 247

I hope to hear from you very soon about the land for
our factory. 248

Yours truly,

James Lang

James Lang, President
Beauty Glass Co. 249

I want to make a decision. 804

April 28

TO: The Mayor of Tinker

FROM: The Park Planning Committee 250

The Park Planning Committee has been working
for three months to decide where to put the new park
that has been planned for Tinker. We have given many 251
hours of thought to this problem. We have looked at
many places which members of our group felt would
be good for a park. 252

At our first meeting in January we made a list
of rules we would use to chose the best place for Tinker's
new park. The most important rule was that the park be 253
put where it is needed most. After all our discussions, 254
we could not decide what kind of a park Tinker needed. 255
Most of the committee did not agree with the final plan
written by Dr. Daniel Jay, though he did agree with our
two final choices of land. 256

The first place is the city block east of the Town
Hall. This would be a city park with gardens, benches,
and a playground. The second place is on the northwest 257
side of Tinker. It is a very large piece of land that has
Blue Water Creek running through it and many hills in it.
This would be a country type park with picnic places,
trails, and baseball fields. 258

We now hope that you will give your ideas on
the best place for a new park. 259

106

PHONE MESSAGE

to: The Mayor

from: Mr. Arnold Moss

date: April 25 **time:** 9:15 A.m.

person taking message: D. Jones 260

message:

Mr. Moss called to tell you that an
Airport Planning Committee has been formed
by a group of business men. They would 261
like you to join them and help them show
the City Council why the city should
build an airport. They hope to show 262
the Council that an airport will make
Tinker an important city for the towns
around it. 263

There has been some talk about this
idea. Several people feel the city would 264
spend too much money for something
that is not really needed. Mr. Moss asked 265
if you would tell the committee your
feelings about a new airport in Tinker. 266
The meeting will be on April 30 at 3:00. 267

I want to make a decision. 806

107

1451 Adams Drive
Tinker, Colorado
April 21 270

The Mayor
City Hall
Tinker, Colorado

Dear Mayor,

The Southside Neighborhood Committee would like to ask the
City of Tinker to fix several of the streets in this part of town. We 271
have had a very hard winter and this spring our streets that are still
unpaved are very muddy. 272

We realize that our homes are new and this area of town is
still being worked on. However, the following streets are very bad 273
and need to be paved now:

April Lane from Jerry Avenue to Lincoln Avenue
Lincoln Avenue from Blue Road to Fish Lane
Round Road from Blue Road to Fish Lane
Jerry Avenue from Blue Road to High Street 274

It has been suggested that each citizen pay for paving the street
in front of his own home. We of the Southside Neighborhood Committee 275
feel this is not a fair plan. All of us have already paid taxes to Tinker, 276
and we feel that it is the job of the City to see that our streets are
paved. 277

The Southside Neighborhood Committee 278

Jim Smith	Dick Hall
Bob Terry	Sue Allen
Ann Nelson	Lee Vale
Bruce Julian	Kim Lawrence

I want to make a decision. 807

108

April 10

TO: The Mayor of Tinker
FROM: Power Supply Study Committee 280

We have been studying the past, present, and future needs
of the city for electric power. For the first twenty years in our 281
history, Tinker had no electricity. We used coal, wood and gas
to supply our heat and light. The first plant provided electricity
for 2,000 people. In 1928 the plant was increased to supply 282
electricity for 5,000 people. It was necessary to build another
part to the plant in 1946 when the population was 9,000. There
have been no further additions to our electric plant since 1946,
although the present population is 12,000 people. 283

We have been able to supply our citizens with enough
electricity but there is some question whether our present electric
plant could supply a large group of new citizens. We must also 284
think about new factories we would like to see built in Tinker. 285
Some of us feel we should add another part to the present plant
now to help Tinker grow. 286

However, many in our group feel that the city should study
the new atomic energy plants in other cities before we think of
adding on to the old plant. These members think we should build 287
a new atomic electric plant in the future. They suggest that Tinker 288
buy the extra electric power that it needs now.

I want to make a decision. 808

1116 North Flower Lane
Tinker, Colorado
April 14 290

The Mayor
City Hall
Tinker, Colorado

Dear Mayor:

Mrs. Fine and I have a problem which we hope
you will take care of soon. Our water pressure is 291
very poor. 292

When we moved to Bander Hill two years ago, the
water pressure was all right. Several months ago, the 293
water pressure became very low in the late afternoon. 294
Last month this problem was much worse. We can now turn
on the taps in the late afternoon and get no water at all! 295

Both my wife and I have called the City Water
Department to ask about this problem, and we have
written two letters to Mr. Albert Teddy. It is the job 296
of the City Water Department to give the people of
Tinker enough water. This is one of the reasons we pay 297
taxes. We hope you will see that the Water Department 298
does its job and improves our water pressure. 299

Yours truly,

Peter Fine

Peter Fine

I want to make a decision. 809

APPENDIX E

GROUP INSTRUCTIONS

FOR PLAYING MAYOR*

We have written a kind of workbook that students will use in school. Since no boy or girl has used the book in school we don't know if it is really any good. So we decided to ask you to use part of it and then see if it works. When you have finished using the materials we will be asking you some questions about what you thought of it, if it was interesting, and whether or not you want to suggest some ideas we should put in it.

The workbook is called I Am the Mayor, and it asks you to pretend that you are a mayor of a small town. What does a mayor do? (Wait for four correct replies--correct the incorrect ones.) That's right; a mayor is the head of a town or city, he sees to it that things get done. People bring all kinds of problems to a mayor: about business, about water, about schools, about safety, about almost anything that goes on in a town. The mayor has to find out things, he has to solve some of the problems himself, and lots of times he asks other people to do jobs.

Before we begin, I would like to show you what your office will look like. Your office is a very modern office. You have a set of dials to dial numbers, an intercom, a viewing screen, and a slot where important papers are given to you. The name of your city is Tinker. It is located in Colorado. You might also want to notice that you have a picture of your city, a calendar, the state seal, and a copy of your index of files where you can find information.

Now I am going to show you how to play the mayor. I will pass out a set of examples which I would like you to follow as I give the instructions. (Pass out folders) May I have a volunteer to be mayor?

As mayor of Tinker you will receive letters, memos, and telephone messages. (Mr. Mayor, if you will put page 112 in the dial you will receive a letter. Thank you.) Now if everyone in the class will please look at Example 1 the mayor will read it to us. (Mr. Mayor, what is the letter about? Good.) The Business Club wants the mayor to be in favor of having the city build a parking lot. (To class) Do you feel that you know enough about Tinker's parking problem to make a decision. (Yes) What would you do? (Answers) Can you think of any reason why you shouldn't decide yet? (Have those who said "no" above answer the question or--(No) What would you need to know about the letter to make a decision? There can be a lot of things you would want to know before making a decision.

---

*Illustrations indicated are in Appendix A and not repeated here.

While you are reading this letter you should try to think of questions you think need to be answered just like we did before. When I read this letter, I think of a lot of questions. See these numbers on the right side of the page? (Yes) Everytime I think of a question I find the number closest to the sentence where I thought of the question. I thought of a question when I read, "We feel the City Council should carefully study Tinker's need for another lot in that part of town." I wanted to know how many parking lots there are already. What page number is closest to the end of that sentence? (322) Has everyone found the sentence? Please dial it, Mayor.

This is what you would get through the slot. Would everyone look at Example 4 and you will see what the mayor is looking at. These are questions from which you can choose. You should choose the questions that are the most like the ones you think of. Would everyone please read those questions and if you would like to ask one raise your hand. (Choose one person to read) Please read it. What page is it on? (Page) Please dial it. Everyone please look at Example ____.

This is what you would get. (Looks) Someone choose another, etc. You can ask for as many question pages as you like. If you thought of questions at each sentence you could dial for all the question pages you want. If you had chosen 321 and 323 this is what else we might have looked at. (Please dial these numbers, Mr. Mayor, 321 and 323.) You can look at as many pages of your files as you like. You could even look up 100 files if you wanted. After you have seen all the files you want to see and you want to make a decision, find the sentence, "I want to make a decision." It is at the bottom of your work page (your letter). What page should you dial? (812) (Choose someone to dial the page number.)

Please read this to yourself. (These are three types of things that you can do, Mr. Mayor. Read these to yourself and dial the number you want.) The mayor has dialed ____. On the screen in front of the mayor, page____will appear. You will see several decisions from which to choose, including one that you can make up yourself. (Mr. Mayor, would you read the decisions to yourself and when you decide what you want to do dial 000 and tell your secretary what your decision is.) You give her the letter of your decision and then read the sentence to her. (Subject dials 000. Yes, Mr. Mayor. Answer. I will do that right away, Mr. Mayor.) Are there any questions?

Before we begin let me tell you a little bit about yourself and your city. Tinker is a small city in a valley on the banks of the Bluewater Creek. You have been away for two weeks on a trip. You have a very short memory and you use your files all the time to help you remember everything you need to know.

Now it is Monday morning. The name of your secretary is Jones. To get your work put the number in the dial that comes at the end of the page. Look at this decision page and tell me the number of your next work (100). Please dial it when you are ready to start to work. While you are reading your work, remember, you should think up questions you feel need to be answered. Then look them up by page number. Dial for as many pages as you want and dial for them as many times as you want. Jones likes to do a great deal of work. You can take as long as you want on any piece of work. You have almost 40 minutes; I will let you know when you have to stop for today. Before you begin, you may look through your files as much as you like. To find anything in your files, first dial page 300. Remember, anytime you want to talk to your secretary dial 000.

APPENDIX F

SCRIPT FOR INSTRUCTION MOVIE*

by

Hedy Zussman

SCENE 1

Shot of a hallway of an office building, man walking down hall toward camera, man stops in front of door marked Mayor. . .he knocks. . .no answer, knocks again. . . no answer. . .hesitates a moment and then turns the door knob. He walks in and starts to take a look around.

Man: Hello, hello. . .Is anyone here? (NO ANSWER, THE MAN LOOKS THE PLACE OVER AND A VOICE SAYS)

Narr: Good morning, Mayor. . .

Man: (TURNS TOWARD THE VOICE) Oh, excuse me, but you must be mistaken, I'm not the Mayor, I was just walking past his office and I thought I'd take a look. I'm really sorry, I'll leave now. . . (STARTS TO WALK OUT)

Narr: No, I'm not mistaken, you are the Mayor of Tinker, at least you are today.

Man: No, honest, I'm not the Mayor, I just walked in here. (AFTERTHOUGHT) I knocked before I came in and no one answered so I just thought I'd take a. . .

Narr: (PAYING NO ATTENTION TO WHAT MAN HAS TO SAY) Your secretary, Miss Jones, told me that you would be in this morning and I am here to help you get organized. Why, you might have walked into another Mayor's office, one like Mayor Dan. . .whose office is very old-fashioned and so is Mayor Dan. . .or that of Mayor Phil the Filer. . .who runs around the office filing all his papers and wears himself out. . . You might have even walked into Pam the Piler's office. . .stacks and stacks of papers piled up on her desk each day but nothing gets done because Pam can't find anything. . .But you, Mayor, are very modern and your office has only the most modern equipment.

---

*Illustrations indicated are in Appendix A and not repeated here.

Man: Oh really, what's so different about this office. . .

Narr: Take a look and I'll show you what your office is like. (WALKS OVER) Here, have a seat at your desk. (THE MAN SITS)

Man: What are these dials for, what is this for, and this screen? (TURNS TO CAMERA)

Narr: Hold on a minute and I'll explain what they are for. Your office is set up with a system of numbers and you use the dials to dial the number you want. . .

Man: It says here that to talk I should dial 000. . . Who will I talk to?

Narr? If you dial 000, you will be able to talk to your secretary, Miss Jones.

Man: (DIALS 000) Miss Jones, are you there?

Jones: Yes, Mayor, can I help you?

Man: No, I just wanted to see if this intercom works. . .

Jones: If you need anything just dial for me.

Man: All right. . .(TURNS DIALS) I dialed 000 and got Miss Jones. What would happen if I dialed another number?

Narr: You have a special code of numbers in your dialing system. Dial 112 and see what happens.

Man: (DIALS 112, PAPER COMES THROUGH THE SLOT) What is this? It's a letter addressed to the Mayor. . .I can't read this.

Narr: Go ahead, Mayor, read your letter.

Man: (UNDER HIS BREATH) If this fellow thinks I'm the mayor then I guess it's all right for me to read the letter. (PICKS THE LETTER UP AND STARTS READING IT ALOUD IN THE BACKGROUND)

Narr: (TO AUDIENCE) The Mayor is reading the letter, you too can read it. Yes, I mean you. Did you think that I didn't know that you are watching. . . I know. . .I knew about the Mayor, didn"t I? I also know that you have booklets in front of you, take a look at them if you'd like, the Mayor is looking at page 112.

Man; It says here that the Business Club wants me to be in favor of having the city build a new parking lot. How can I be in favor of building a parking lot when I don't even know if Tinker needs one? I need to have a lot a questions answered before I can even consider doing anything about this. . .First of all, I've got to know how many parking lots Tinker has already. . .Then, I'd like to know if other people think that Tinker needs a new parking lot. Also, how many cars are there in Tinker now? How many people shop in Tinker and do they shop at the same time? Say, I'm really not the Mayor so I don't know the answers to all these questions. . . or even where to find the answers!

Narr: Mayor. . .Mr. Mayor. . .

Man: Oh, it's you again. . .honest, I'm not the Mayor. . . I just was walking by and. . .

Narr: But you are the Mayor. . .and you've got a lot of work to do. . .so why don't you stop fighting it and get to work?

Man: O.K., if you insist. . .I'm the Mayor. . . and I read this letter from the Tinker Business Club about the need for more parking lots. . .but I can't do anything about the parking problem. . . I have a lot of questions about this but I don't know where I can find the answers.

Narr: Mayor, if you will look at your letter, you will see a list of numbers on the right side of your page--yes, that's right--(SHOT OF LETTER WITH NUMBERS). These numbers represent page numbers which you can dial for to get pages of questions like the ones you thought of. All you have to do is dial for the number you want. . .

Man: How do I know what number to choose?

Narr: As you read the letter you thought of questions which you wanted answered. . .If you thought of a question when you read the first sentence, then you would dial the number which comes after that sentence.

Man: I thought of a question when I read this sentence (POINTS TO SENTENCE). . . "We feel the City Council should carefully study Tinker's need for another parking lot in that part of town." The number which comes at the end of the sentence is 322.

Narr: Well, then dial it. . .(TO AUDIENCE) The Mayor is dialing for page 322.

Man: (DIALS 322, THE QUESTION PAGE COMES THROUGH THE SLOT, THE MAYOR PICKS UP THE PAPER AND LOOKS AT THE QUESTIONS) He was right, there are questions here that are like my own. . .Let's see. . .the first question says, "How many parking lots are there in downtown Tinker? I would like to see a map of downtown Tinker." Hey, there's a page number after the question. I bet I'm supposed to dial the number in order to see the map. I wonder where the map will show up. . .in the screen perhaps. . .(DIALS 363)

Narr: What number did you say you dialed, Mayor?

Man: I dialed 363. Let's see I'm looking for all the parking lots. . .Here's one on Able Avenue which intersects Marshall Street. . .I can't find any others. . .that doesn't seem like enough. . .only one parking lot. . .but maybe it can handle all the cars. . .I'm going to look at that question page again and see if there is anything about the number of cars there are in Tinker. . .

Narr: The Mayor has gone back to look at 322 again,

Man: Yes, here's the question I am looking for. . .How many parking spaces are available in downtown Tinker now? I would like to see the Traffic and Parking Chart. The number I should dial is 599. (THE MAN DIALS 599 AND THE PAGE APPEARS ON THE SCREEN)

Narr: Did you say you dialed for 599, Mayor?

Man: Yes, I did. This one appeared on the screen too. . . It says that there were 3,000 cars in Tinker last year. . .and in the second column it states that there were only 500 parking spaces. . .(THE MAYOR SITS BACK IN HIS CHAIR, PUTS HIS HANDS BEHIND HIS NECK AND SAYS) I can just picture what it's like during the heavy shopping hours. . .people looking for parking spaces. . .I guess I'd be upset if I couldn't find a parking space myself. Of course the parking lot could be completely empty too. (CLIP-EMPTY) If there is a need for the parking lot, how are we going to pay for building it? (LOOKS BACK AT HIS QUESTION PAGE TO SEE IF IT CAN HELP HIM) I can't find my question. . .but this last statement says," My question is not here, I would like to see a list of all my files" . . .The number that comes after it is 300. (DIALS FOR 300, IT APPEARS IN SCREEN) This is getting to be a lot of fun. . .All I have to do is dial for the page I want and it appears on the screen. . .I wonder what I'll find on page 300.

Narr: I know what he will find on page 300--a list of. . .

Man? Here it is, there is a section on General Information, Departments, Current Business, and Letters. I have 20 files to choose from too. . .Let's see, maybe I can find a file on City Budgets. . .(THE MAYOR LOOKS AT HIS FILES)

Narr: While the Mayor is looking for the files he wants, let me show you what Miss Jones, his secretary, does in order to make his files complete. . .When the Mayor receives letters, reports, messages, and other important papers through the mail, or on the telephone, Miss Jones files them by her special code system so that the Mayor can easily find what he is looking for. . .Mayor, did you find what you were looking for?

Man: I sure did, under Current Business, I found a file on City Budgets and Money. It looks like the city could afford a new lot if there is a real need for one. I also looked at some letters from people about the parking problem. . .Many people feel that Tinker needs another parking lot. . .Say, Mr. What-ever-your-name-is, I've been wondering about something.

You remember the letter I got from the Tinker Business Club. . .you know, this one. . .(HOLDS UP LETTER)

Narr: Yes, I remember. It is page 112. I bet he's going to ask me about the other numbers along the side of the page. . .What about the letter?

Man: Well, am I only allowed to dial for one page of questions?

Narr: No, you can dial for as many of the question pages as you'd like, if you would like to see all the question pages, you can dial all the numbers on the right side of the page. . .you can even dial for all the files you want. If you'd like to see a file page more than once you can do that too. . .

Man: Won't Jones be upset if I do. . .

Narr: No, Mayor, she likes to do this work and in order for you to remember everything you need to know, you should use your files all the time. . .

Man: I think I've looked at all the files that I want to on this parking problem, now what do I do?

Narr: Look at the bottom of your letter from the Business Club. Page 112, Mayor. There is a sentence which says. . .

Man: Hold on, you don't have to tell me. . .the sentence says, "I would like to make a decision" and I'm supposed to dial the number that comes after it. . .right?

Narr: That's right. . .The number is 812. The Mayor has found that there are three different types of things to do. . .when the Mayor decides, he will dial the page that he wants. You can look at your own page 812 and see if you agree with the Mayor. (THE MAYOR DIALS 904) He has dialed for 904. . . That's the sentence which says, "I need to find out something that is not is my files." Mayor. . . excuse me for interrupting you but. . .

Man: Well, what is it? I haven't got all day you know. I'm very busy, and besides I want to look at the paper in my screen. . .

Narr: I just wanted to tell you that when you've decided what to do, dial for your secretary and read the sentence of your decision to her--be sure to tell her the letter of the decision. . .

Man: Thanks. . .(GOES BACK TO PAGE ON THE SCREEN, READS THE DECISION ALOUD IN ORDER) (IN THE DISTANCE) All of these are good decisions but after looking at my files which gave me a lot of information I think I'll choose D.

Narr: The Mayor has made a choice. Which one would you choose?

Man: (DIALS 000) Jones. . .Jones. . .are you there?

Jones: Yes, Mayor, may I help you?

Man: Yes, you can. (SITS BACK IN HIS CHAIR) I chose D. I need to know something else.

Jones: What would you like to know, Mayor?

Man: (FADES SLIGHTLY) First I would like you to write to the state government and ask them for information concerning the average number of parking spaces needed for a city of this size in a business district. Then I would like you to call a meeting of the Business Club members to meet with me. . . Also. . .

Narr: For a person who kept insisting that he wasn't the Mayor, he certainly is acting like one. . .Mayor. . .

Man: Now, what do you want. . .

Narr: When you have decided what to do, there is more work on page 100. . .

Man: Yes, I know, at the bottom of the page in the screen there is a sentence which tells me what page I am to dial. . .(DIALS PAGE 100)

Jones: (TURNING DIAL BACK TO 000) Excuse me, Mayor, but you'll have to stop working for today because you have a meeting to go to. . .

Man: Thank you, Jones. . .It slipped my mind. . . (MAYOR PICKS UP HIS THINGS AND STARTS TO WALK OUT THE DOOR. . .LOOKS INTO THE SCREEN AND SAYS) Look everyone, I'm really not the Mayor of Tinker.

I just accidentally walked into this office and decided to look around. . .then this voice started talking to me and, well, you know the rest. . . (WALKS OUT THE DOOR, CLOSES IT, LOOKS AT CAMERA AND SAYS) Do you really want to know who the Mayor of Tinker is? You are. (MAN TURNS AND MUSIC IS HEARD AS HE WALKS DOWN THE HALL AWAY FROM THE CAMERA)

OE 6000 (REV. 9-66)

DEPARTMENT OF HEALTH EDUCATION AND WELFARE
OFFICE OF EDUCATION

ERIC REPORT RESUME

(TOP)

ERIC ACCESSION NO.

CLEARINGHOUSE ACCESSION NUMBER

RESUME DATE 5-7-68 P.A. T.A.

IS DOCUMENT COPYRIGHTED? YES ☒ NO ☐

ERIC REPRODUCTION RELEASE? YES ☒ NO ☐

TITLE

THE TEACHING OF INQUIRY SKILLS
TO ELEMENTARY SCHOOL CHILDREN
USOE PROJECT NO. 5-0594, FINAL REPORT

PERSONAL AUTHOR(S) Allender, Jerome S.

INSTITUTION (SOURCE) Miami University, Oxford, Ohio, School of Ed. SOURCE CODE

REPORT/SERIES NO. OE-3279

OTHER SOURCE SOURCE CODE

OTHER REPORT NO.

OTHER SOURCE SOURCE CODE

OTHER REPORT NO.

PUB'L. DATE 5-31-68 CONTRACT GRANT NUMBER OE-6-10-158

PAGINATION, ETC.

174 pp.

RETRIEVAL TERMS

IDENTIFIERS

ABSTRACT

The purpose of this project was to describe inquiry behavior in grade school children and to test for the effect of teaching methods and environments on their inquiry activity. Inquiry scores were derived from records of information processing made while the children played the role of mayor of a small simulated city. Movies, programed texts, and discussion guides were used in a learning center under teacher and student direction. It was found that children will independently engage in inquiry activity when given the opportunity. The children who spent more time, saw more problems, asked more questions, and used more information. The environment designed to teach inquiry significantly increased inquiry activity. Evidence was also found that teacher direction in the environment is unnecessary for the increase of inquiry activity.

OE-BR
PS
meat

FROM:

ERIC FACILITY
SUITE 601
1735 EYE STREET, N. W.
WASHINGTON, D.C. 20006